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COMMUNICATIONS FOR TRANSPORT
DECISION-MAKING IN
DEVELOPING COUNTRIES

Paul S. Shapiro

with contributions by
R. M. Longenecker, W. L. Eilers, and H. H. Davids



RESEARCH PROGRAM ON PROBLEMS OF INTERNATIONAL
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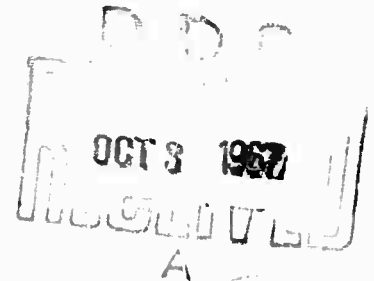
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Communications or Transport:
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Research Program on Problems of International
Communication and Security*

Center for International Studies
Massachusetts Institute of Technology
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SUMMARY

Comparison is made of the uses of investment in transport and in communications for developing countries. A method for investment decision-making is proposed, and relevant data are presented and analyzed.

It is hypothesized in the Introduction that in achieving such development goals as modernizing images, attitudes and behavior, fostering political integration, promoting economic growth, and advancing education, transport and communications may be substitutable or at least complementary.

In Chapter I national investment strategies are seen to depend on Communist or non-Communist ideology, on theories of economic planning, on situational conditions, and on methods of analysis. The construction of rural roads is posited as the major transport investment for developing countries in the future. It is suggested that increased rationality in decision-making in the transport and communications sector is possible through the application of cost-benefit analysis at the village level. This is seen to require the collection of cost and descriptive data for a range of communications media and for various types of roads, as well as increased knowledge of the benefits they afford. A model is proposed for the staging of investment.

A comparison of some benefits of transport and communications is made in Chapter II through an analysis of data from a 1962 national sample survey of Turkish villages. Correlational data across survey villages are analyzed and then villages near or far from a road and with no, one, or many radios are com-

pared on the basis of 23 personal, political, social, economic, and transport/communications indices. It was found that the mass media were highly effective in inducing in the villagers many of the attitudes now considered essential for development, that the mass media alone were far more effective in inducing these attitudes than was proximity to a road alone, that the mass media did not inculcate in the villagers the ostensibly harmful attitudes which some have feared they might, and that the results give strong support to the presumption that the relation between the presence of the mass media and of modern attitudes is one of cause and effect.

In Chapter III the use and cost of radio in developing countries is examined. UNESCO-sponsored experiments in Asia and Africa found that both knowledge and community action were increased through group listening and discussion of special broadcasts more than through the simple provision of radio sets. For technical reasons doubt is cast on the advisability of relying upon inexpensive transistor radios for individuals to meet suggested UNESCO minimum standards of reception. Wired radio (or rediffusion), little known in the United States, is proposed as an alternative. Data from South Korea show that wired radio systems, owned by private entrepreneurs, are less expensive, provide better reception, and possibly offer a greater range of program choices than do transistor radios. Costs for components of wired radio systems are provided.

In Chapter IV it is shown that the telephone, under some conditions the most direct substitute for transport, has received little attention from either development planners or

communications thecrists. Telephone can, nevertheless, provide communication in rural areas when roads are impassable or non-existent. It was found that, under these conditions or when the need for communication is low, two-way radio is less expensive to install and maintain than is telephone wire. Examples of national (Nepal) and regional (East Pakistan) two-way radio systems are described. Generalized specifications and costs for city-village two-way radio are provided for the conditions of average or hilly terrain, for distances up to 50 miles, and for antennas of various directionality. Two-way radios designed for use in South Vietnam are described.

In the Conclusion the problems of providing appropriate communications equipment at low cost and the need for training and organizing personnel are discussed.

° The Appendix provides an analysis, based on the literature extant, of the possible contributions of transport and communications to development.

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FOREWARD

Thirty-five percent of the value of loans by the International Bank for Reconstruction and Development have been for transportation. Half of one percent have been for development of communications. This may represent a rational allocation or maybe it does not. The question of how much to invest in communication and how much in transportation in developing countries has never been adequately explored.

Communication and transportation are to some degree substitutable commodities. They both serve to weld a developing country into an interacting unit. They both help to widen markets, create a national identity, overcome tribalism and parochialism, facilitate technological advance, and broaden knowledge. Communication facilities are usually cheaper than transportation facilities. Since they may sometime serve the same purposes, one wonders whether savings cannot be achieved by putting more emphasis on communications development than has been customary in the past.

Needless to say communication and transportation are not always interchangeable. The village headman can talk to the local governor by telephone or two-way radio even without an all-weather road or bus service, but crops cannot be moved electronically. Nor is it even clear that the psychological effect of listening to the radio is the same as that of wandering around a city market place. The Center for International

Studies started this study without preconceptions as to what the degree of substitutability is. Our only preconception is that the problem is one that needs to be investigated.

Non-communist developing countries have on the whole devoted very little effort to communication investment. Whether because they fear the social and political demonstration effects of the mass media, or whether because the press and some other mass media have traditionally been in the sphere of private enterprise, or whether because the impact of communications channels is often hard to measure in any but trivial ways, the fact is clear that non-communist developing nations have been notably reluctant to utilize their scarce resources in communication investments. The countries providing aid have not encouraged them to do so either. Perhaps this has been a mistake.

The interaction and interchangeability between transportation and communications is something that scholars in each field have long discussed vaguely. The topic has been of interest to the Transport Research Program at The Brookings Institution. It has been of interest in the international communications research of the Center for International Studies at M.I.T. Dr. Wilfred Owen of Brookings requested CENIS to undertake this study. While we recognized that this study was something of a gamble, treading completely untrod paths, it was so central to the continuing interests of our research program that we decided to give it a try. Papers were initially written for a seminar by Messieurs Shapiro, Langendorf, Albert Teich, and Eilers.

Mr. Shapiro then carried the work forward to its present stage of quite promising development. This paper represents a first serious attempt to introduce some rigor into the discussion of an important subject.

Ithiel de Sola Pool

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Contributors to the paper have been Mr. Richard Langendorf of the Department of City and Regional Planning, M.I.T.; Mr. William L. Eilers of the Asia Foundation, who was on leave at M.I.T. during the 1964-65 academic year; and Mr. H. H. Davids, consultant to the General Electric Company. Special appreciation is due to Mr. R. P. Gifford, General Manager of the Communications Products Department of the General Electric Company, at whose request Mr. Davids' services were made available. Credit goes to each of the contributors for the parts they have originally written. As all editing of the complete work has been done by the author, responsibility must fall on him for any errors which may have resulted.

Mr. Wilfred Owen of the Brookings Institution conceived the idea of this paper. Professor Ithiel de Sola Pool of M.I.T. was the adviser for the researching and the writing. His insight and guidance have been inspiring. Helpful criticism was received from Dr. David Kendrick. Portions of this monograph have benefited from the scrutiny of Mr. Edwin T. Haebele, under whose direction a shorter version was prepared for inclusion in the forthcoming Brookings Institution volume Relating Transport to National Policy, of which he is the editor.

Professor Frederick W. Frey of M.I.T. has been most generous in giving permission to use the Turkish survey data. His forthcoming publications analyzing the survey as a whole should be a major addition to the literature on survey research in developing countries. Publication of the present work has been approved by the survey's sponsors, the Government of Turkey and the United States Agency for International Development.

Thanks are due to M.I.T.'s Project MAC (Multiple Access Computer)* and to the staff of the Research Program on Problems of Communication and International Security for making possible the tabulations of the Turkish data. Mr. Allen Kessler, Mr. Noel Morris, and Mr. Thomas Van Vleck advised on the data processing.

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Much of the technical data on communications equipment presented in this paper cannot be found in readily available source materials. It has been obtained through the help of salesmen, researchers, managers, and field personnel in industry, government and other organizations, both in the United States and abroad. Many of these individuals have been cited in the text. To all of them the author is indebted.

Presentation of information on Rural Radio Forums was made possible through the cooperation of the Mass Communication Techniques Division of UNESCO, in particular Dr. Henry Cassirer and Mr. F. L. Goodship.

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INTRODUCTION

CHAPTERS

APPENDIX

INTRODUCTION

To bring about the improvement in living conditions that the developing nations are striving to achieve requires the careful coordination of numerous investment sectors. Investments in irrigation and power, in agriculture and industry, in education, housing, and community development--all contribute their share to the development process.

Cutting across all these sectors of investment are transport and communication needs. Movement of goods, people, and messages are ubiquitous. If the capacity of transport and communication systems does not keep pace with the expanding needs of developing countries, bottlenecks in the development process occur.

Comparisons between the developed and the lesser developed countries reveal substantial differences in transport and communication systems. Furthermore, the gap is widening. For example, in 1960 road building investments in the European Economic Community averaged \$4,500 per square mile, as compared to \$102 in Latin America and only \$33 per square mile in Africa.¹ Expansion of the electronic media is also often proceeding at a more rapid rate in the developed countries than in the lesser developed.²

¹ Wilfred Owen, Strategy for Mobility, Brookings Institution, Washington, D.C., 1964, p. 12.

² Cf. UNESCO World Communications, New York, 4 editions, the latest being December 1963.

Efforts to close this gap, or to maintain a balanced development pattern, require major investments in transport and communication. This has been reflected in the development plans of the developing nations and the loan commitments of the world banks. For example, transport and communication investment in India's Second Five Year Plan accounted for 30% of the total investment, in Pakistan it accounted for about 20%, and in Colombia it is planned to consume over 20% of the investment by the national government.¹ Between 1946 and 1963 over 35% of the value of loans by the International Bank for Reconstruction and Development were for transport and communication. In Africa such loans accounted for 48% of the assistance given.²

Currently, almost all of this investment is in transport; comparatively little is for communication. For example, communications represented less than 0.5% of the loans by the IBRD. In the Second Five Year Plan of India, the amount allocated for communication was less than 6% of the amount for transport; in the Third Plan 4.5% of the 20% allocated for this sector was for communications, or 0.9% of the total. Although investment in communications equipment is often much less costly than in construction of transport facilities, it has consistently been given a much lower priority.

¹ Cf. Planning Commission, Selected Plan Statistics, Government of India, New Delhi, 1963; cited in Owen, op. cit., p. 41 and based on data from Revista Banco de la Republica, Bogota, Colombia, December 1961.

² International Bank for Reconstruction and Development, Eighteenth Annual Report 1962-63, Washington, D.C.

Communication and transport, however, are inter-dependent. Therefore, there is a continuing need to re-examine the effectiveness of these investments, asking such questions as (1) which of the many goals of development can transport and communication achieve, and (2) when there is an interaction, what is the most efficient form of investment to achieve a given goal.

Based on the literature now available (see Appendix), a number of hypotheses can be made about the possible contributions of transport and communications, and the possible substitution of one for the other, in some of the important aspects of development. First, in modernizing images, attitudes, and behavior, little is known about the effects of communication. Even less is known about the effects of transport. However, hypotheses might be put forward that (1) both transport and communications are effective modernizers in this respect; (2) that mass media communication is particularly effective when combined with a personal message mediator; (3) that transportation is particularly effective when access is provided to a notably different environment, especially one with improved opportunities, and (4) that in many circumstances transport or communications could be substituted one for the other to modernize images, attitudes, and behavior.

In respect to political development, it might be hypothesized that (1) both transport and communications systems contribute to political integration and national development through reducing isolation, and (2) that they contribute in essentially different ways so that one could not be substituted for the other in achieving these goals.

In the area of economic development the following hypotheses are offered: (1) Both communications and transport can provide significant assistance to economic development goals. (2) Transport, in moving goods and people and in affecting land development patterns, influences economic development in important ways that communications cannot. (3) Communications can play an important role in reducing uncertainty in economic decisions. (4) In extending market areas, in better integrating markets, and in encouraging a better distribution of labor, transport and communications contribute different, but complementary, benefits. (5) In encouraging innovations and their recognition and diffusion, transport and communications development may each be substituted for the other.

Finally, the following hypotheses related to education may be made: (1) Both transport and communications can contribute to education in significant ways. (2) Expanded use of the mass media for educational purposes in rural areas may require considerably less capital investment than expansion of transport facilities. (3) Within urban areas investment in increasing the mobility of children may have important educational benefits. (5) For adults the mass media can provide an informal education by means of its information-carrying capacity.

The exploration of the ability of communications to substitute for transport is a complicated exercise. Many of the above hypotheses will be examined either directly or inferentially in the section of this paper dealing with the Turkish survey. The exploration, however, also requires extending present knowledge of the goals that transport and communications

can achieve, and anticipating likely technological innovation. It requires developing better methods of cost-benefit analysis to evaluate alternative investments. Finally, any conclusions clearly depend upon the selection of specific development strategies and the particular circumstances at the investment location.

This paper will attempt a partial answer to the challenging problem of how decisions can be made in allocating limited resources between transport and communications in developing countries.

Chapter I. The Strategy for Decision-Making

In the Introduction hypotheses were made of possible contributions of transport and communication to development. It is clear that their contributions are not identical. Both may achieve certain goals in such a manner that one can be substituted for another. However, certain goals can only be achieved by investment in transport and some by investment in communication. Thus the decision to invest in one, or the other, or both, will depend upon a number of additional considerations which will, however, not be explored in any detail.

A. Strategic Considerations

The decision to substitute investment in one sector for investment in another will most likely result more from consideration of general development strategies than from detailed cost-benefit analysis. It has been suggested that transport and communication separately have particular advantages for achieving different goals. The relative importance attached to the various goals will depend in large part on the development strategy.

For example, the Communist countries have placed great importance upon propaganda and have consequently allocated more funds for communications than have the neutral nations.¹ Conversely, many underdeveloped countries have invested lightly

¹Cf., Yu, loc. cit., (in Appendix).

in the media because of concern for the inflationary effects of increased demand that they envisage will result from communications investment. Yet, some economists would suggest that increasing demand would be beneficial to the economy, while others may argue the media need not increase demand.

Other types of issues arise. For example, some economists will place more emphasis on investment in the heavy industries,¹ which will generate a need for railroads that may be highly conspicuous if bottlenecks occur. Other economists may favor investment in agriculture for which railroads do not offer such clear advantages.² Still other economists will emphasize investment in social development--in health, education, and the like.³

The relative importance of industry and education can be stated in more general terms as the comparative advantage of investing in directly productive activities or in social overhead capital.

Another difference in emphasis arises between those who favor balanced development, and those who favor an unbalanced development, either on grounds that a "big push" is necessary

¹Cf. Hirschman, loc. cit.

²Cf. Agricultural Production Team, Ford Foundation, Report on India's Food Crisis and Steps to Meet It, Government of India, 1959.

³Cf. Harbison and Myers, loc. cit., Mukerji, B., Community Development in India, Orient Longmans, Calcutta, 1961.

or that investment must be induced through creating imbalances.¹ Schramm and others who argue for communications investment present an organic growth model of development in which communications is expected to develop in a pattern consistent with the rest of the society.² In contrast, others will argue that government should not worry about communications investment, for if an imbalance occurs, it will induce the requisite investment and correct itself.

Other issues in development strategy result from differing perceptions of development bottlenecks. Some see major obstacles resulting from inadequate investment capital or industrial development, while others view inadequate markets as a more serious problem. Still others consider political integration or administrative organization as more critical bottlenecks.³ Some attribute underdevelopment to the attitudes, values, and beliefs of a population--to entrepreneurial ability, propensity to innovate, non-achievement, particularism, and the like.⁴ The perception of the development problem will affect

¹Cf. Hirschman, loc. cit., Rosenstein-Rodan, P. N., "Notes on the Theory of the Big Push", Center for International Studies, M.I.T., Cambridge, 1957; Singer, Hans, "The Concept of Balanced Growth and Economic Development: Theory and Facts", University of Texas Conference on Economic Development, April, 1958.

²Schramm, loc. cit.

³Cf. Swerdlow, Irving (ed.), Development Administration: Concepts and Problems, Syracuse University Press, Syracuse, 1963; Pye, loc. cit., LaPolombara, Joseph (ed.), Bureaucracy and Political Development, Princeton University Press, Princeton, 1964.

⁴Hagen, loc. cit., McClelland, loc. cit.; Schumpeter, Joseph, The Theory of Economic Development, Oxford University Press, New York, 1961; Weber, Max, The Protestant Ethic and the Spirit of Capitalism, Allen and Unwin, London, 1930.

the selection of strategies and the priorities assigned to the various goals. It will consequently affect the relative importance assigned to transportation and communications investment, and the evaluation of the ability of one system to substitute for the other.

Situational Conditions

Differences in strategies of development may also result from different situational conditions. For example, countries in Africa may have few structural impediments to economic development, but they may lack the organizational capacity.¹ In contrast, the feudal land patterns in Latin America and the Middle East may require land reform and precipitate political conflict.² India may have reasonably adequate administrative organization and political stability, but it lacks capital.³ Each of these situations will call for different development priorities.

Rostow has divided countries according to stages of

¹ Cf. Swerdlow, loc. cit., LaPolombara, loc. cit.; McWilliam, M. D., "Economic Viability and the Race Factor in Kenya", Economic Development and Cultural Change, Vol. 12, No. 1, October, 1963, pp. 55-69.

² Cf. Baran, Paul, "On the Political Economy of Backwardness", The Manchester School reprinted in Agarwala, N. N. and Singh, S. P. (eds.), The Economics of Underdevelopment, Oxford University Press, New York, 1963, pp. 75-93; Hirschman, Albert, Journeys Towards Progress, Twentieth Century Fund, New York, 1963.

³ Cf. Rosenstein-Rodan, P. N., "Economic Assistance Requirements for Underdeveloped Countries", The Review of Economics and Statistics, Vol. 43, No. 2, May, 1961, pp. 107-138; Lewis, John, op. cit.

development.¹ He distinguishes between periods of growth and suggests that each period will have its characteristic problems. Social and cultural impediments to development predominate in the earlier stages, but become less important as the process of evolution unfolds.

As one shifts from general classification systems to individual case studies and investigates physical conditions, the differences between countries becomes even more pronounced. The distribution of resources, demography, topography, and numerous other factors will influence the transport and communication requirements for development.

Not only will countries have differing needs, but they will already be providing different levels of service. The marginal productivity of a given investment will depend upon the existing level of development. In a given context, then, a generalized choice between investment in transport and communications might be as follows: given that 90% of the villages are within 5 miles of an all-weather road, that 2% of the villages have telephones and 10% have radios, is it better to (1) extend all-weather roads to within 5 miles of all villages, (2) extend all-weather roads directly to major agricultural market centers, or (3) provide all villages with radios and telephones?

Historically-based answers to these questions may not be applicable now. Railroad investment, for instance, has

¹Rostow, W. W., The Stages of Economic Growth, Cambridge University Press, Cambridge, 1960.

been closely associated with the economic development of England, Japan, and the United States. However, in India, between 1849 and 1947 there was little economic development associated with the railroad network established by the British.¹ The railroad served the British needs for export rather than the domestic needs for internal economic development. In addition, the railroads that once played so important a role in the development of the United States are now subject to increasing competition from the automobile and the truck. A clear case can not be made for the railroad in promoting economic development unless specific conditions are detailed, and unless alternative modes of transportation are compared.² In the San Lorenzo area of Ecuador, however, change has been greatly stimulated by the construction of a railroad line linking the highlands with the coast.³

There is the related issue of technological innovation and technological obsolescence. For example, television may not be an effective means of communication in large, undeveloped countries because of the limited range of broadcasting stations and their comparatively high costs. However, the new communications satellites may provide a means for overcoming such

¹Cf. Thorner, Daniel, "The Pattern of Railway Development in India", Far Eastern Quarterly, Vol. 14, No. 2, February, 1955, pp. 201-216.

²Cf. Martin Klein, "The Atlantic Highway in Guatemala - A Study in the Effect of Providing a Competitive Mode of Transportation in a Developing Economy", The Brookings Institution, forthcoming.

³N. E. Whitten, Jr., Class, Kinship and Power in an Ecuadorian Town - The Negroes of San Lorenzo, Stanford University Press, Stanford, 1965.

difficulties.¹

The effectiveness of investment will also depend upon the requirements and performance of maintenance. Numerous capital improvements in underdeveloped countries have been rendered useless in a few years because of inadequate maintenance.² Roads deteriorate because of lack of upkeep, and radios become useless when spare parts are not available (see section on wired radio).

Thus the effectiveness of an investment in transport and communication will depend upon constraints set by public policy, upon organizational capability and maintenance requirements, the need for a given project and the ability of the project to fulfill the need (the quality of project planning), and upon the level of technology and prospects of technological innovation.

Efficiency of Investment: Cost-Benefit Analysis

In order to rationally evaluate whether communications investment could be substituted for transportation it would be desirable to be able to evaluate the costs and benefits of the alternative forms of investment.

A good cost-benefit analysis is not easy to make. In the first place there are difficulties in determining the costs. An evaluation of capital improvements may require long range projections that may be somewhat unreliable in anticipating

¹ Cf. Jaffe, Leonard et. al., "The Impact of Communications Satellites on the Less Developed Areas", Communications, Vol. XII, United States Papers prepared for the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, U.S. Government Printing Office, Washington, D.C., 1962, pp. 115-135.

² Cf. Hirschman, Albert, "The Maintenance Problem and a Suggested Solution", The Strategy of Economic Development, Yale University Press, New Haven, 1958, pp. 139-143.

changes in materials and labor costs.¹ Maintenance costs may be even more difficult to predict. Furthermore, the total costs will involve not only initial capital investment, but interest and other carrying charges. Foreign exchange demands and the availability of financing by international agencies may also be important, and may serve as constraints or incentives that distort project comparison.

Benefits are even more difficult to evaluate. For example, the useful life of transport investments may be 50 or 100 years. Predictions as to the usefulness of such investments over the project lifetime will be relatively unreliable. Changes in population distribution, demand requirements, and technology in a society of rapid change will render such projections suspect.

In addition there is the difficulty of quantifying benefits for purposes of comparison. It is relatively easy to measure the requirements for moving fuel to the steel mills, or for distributing agricultural or manufacturing products to their markets. It is much more difficult to measure contributions made by modernizing images, attitudes, and behavior, or by increasing the sense of national identification, though these are by no means less important. If quantitative methods are used for investment decision making, there is a temptation to include in

¹Cf. Morgenstern, Oscar, On the Accuracy of Economic Observation, Princeton University Press, Princeton, 1963; Altouncey, E. G., "The Role of Uncertainties in the Economic Evaluation of Water Resources Projects", Stanford University Institute in Engineering, Economic Systems Report EEP - 7, 1963.

the calculations only those benefits that can be quantified easily. It is likely, therefore, that efforts at increasing rationality will tend to favor transport investment as its benefits are more readily quantifiable.

There is an added difficulty resulting from extending comparisons beyond transport and communications investments. For example, it has been noted that communications investments may substitute for education investments. Many other substitutions are possible. To meet demands for distribution of perishable food products, investment may be made in transportation, in food storage facilities, or in food processing plants. Technological improvements in fish farming or very intensive gardening may permit most of the perishable food-stuffs to be produced at the outskirts of metropolitan areas, thereby reducing transport requirements.¹

The analysis of the contributions of transport and communications suggests that they confer benefits upon many different segments of national development. Cost-benefit analysis has proved most successful for comparing relatively isolated projects, although research on evaluation of inter-dependent projects is now underway.² If the full impact of transport or communications investments is to be accounted for, however, it may require substantial extensions and improvements in analytical techniques.

Thus the quantitative rational evaluation of investment alternatives is a formidable task. Nevertheless, this need not give

1

Cf. Meier, Richard, Science and Economic Development: New Patterns of Living, John Wiley and Sons, New York, 1956.

²Eg., in the Civil Engineering Department at M.I.T. and in the Transport Seminar at Harvard (see below).

rise to pessimism. In the first place, techniques of analysis are constantly improving. In the second, there is no reason why qualitative considerations cannot be given weight in rational decision making. In the third place, while it is quite likely that the need for both transport and communications investments will far exceed available resources, a less than "optimum" decision may still be a "good" decision because the flexibility of modes for extending communications linkages permits the rectification of earlier inefficient investment patterns.

B. Use of Micro-Analysis

With over two-thirds of the population living in villages, a major problem of all developing nations is drawing the rural populace into the economy and the society. This is the problem which clearly juxtaposes transport and communications. As the possibilities for applying transport or communications investment become more widespread (i.e., more local) within a country, the number of unique situations encountered will rapidly increase. This will require, therefore, (1) that a greater range of alternative investment possibilities be offered to cover the diversity of local situations, and (2) that the decision-making be carried out in conjunction with local officials, if that is feasible, or at least with the specific local conditions in mind. Utilizing a micro-analytic approach would therefore seem to hold the promise for considerable advances in decision-making in the communications and transport sector.

Using micro-analysis requires the making of a number of

decisions. Once a national allocation for transport and communications has been decided upon, a decision must be made as to how many and which villages will receive part of the allocation (in a sense also asking the question whether there is a minimum amount which must be invested in individual villages or in a region in order to create sufficient benefits to warrant the investment).

A starting point for making these local decisions has been indicated by the Expert Advisory Committee appointed to follow-up the 1963 U. N. Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas. They say that while the

media are now increasingly used in the developed countries (for which special methods and techniques have been, and are still being, worked out),... they will require considerable and perhaps fundamental, adaptations if they are to be applicable to the needs of the developing countries and particularly to, for example, villages with small populations and inadequate communications in rural areas. Clearly, for such countries the initial step should be a survey of existing needs and resources and the devising of methods and media by which such available resources as exist can best be adapted, employed and supplemented to meet local conditions and local needs.¹

This report will not attempt a broad survey of existing resources, but it will examine two means of communication--one individual and the other mass--which can augment current communications resources. These two means of communications are (1) the

¹Advisory Committee on the Application of Science and Technology to Development, Second Report, May, 1965, Economic and Social Council Official Records: XXXIX session, Supplement No. 14.

telephone (or two-way radio), which can link rural villages to the urbanized communications centers, and (2) radio, which is generally acknowledged as the cheapest and most widely applicable of the mass media. Almost all developing countries are in large part covered by radio broadcasts; future investment ought to be made more for the installation of additional receivers (as well as in program planning) rather than for building additional transmitters.

The range of possible alternatives of communications facilities for villages would vary from the installation of a single battery-powered radio in the home of the headman of a village to the organization of school systems which employ educational television with feedback mechanisms to the broadcast station, as in American Samoa. No matter what the village level, those planning its development should be aware of the options in communications equipment so that they can decide whether further investment should be made in communications or in some other area of development--transport, in particular.

It follows that a similar range of choices needs to be developed for the full range of transport options open to the village. Limiting the discussion to roads only, these choices could range from a dirt trail passing near the village to the construction of a hard-surfaced road directly tying the village to a major trading center in the vicinity.

Consideration is given here to roads only because their construction, which brings access to rural villages, is most likely to be the major future transport investment in developing countries. Thus Owen has observed that "especially important is

the need for appraisal of how transport demands might be averted altogether. It is this approach that holds the hope for directing a larger share of development efforts to neglected programs of housing, health, education, agriculture, and industry.... We need an imaginative program of research and development that will focus on new techniques of transport and new techniques for avoiding transport."¹

Using a micro-analytic approach, cost-benefit analyses could well be utilized in deciding what type of transport and/or communications facilities ought to be provided for individual villages or groups of villages. By not necessarily dealing with large areas, some of the more intangible requirements, such as equal political treatment, may be more clearly delineated and thereby perhaps more easily resolved. Problematical but quite typical situations to which this method could be applied are not difficult to imagine: If a village has no road and no telephone, for example, in which should it invest to connect it to a nearby city? Or if a village has only a dirt road and no communications, should it improve the road, put in a telephone, or install radios in half the houses in the village? No a priori answers exist for these questions, but a start can be made in specifying the costs and benefits of selecting and achieving given objectives available among the range of possibilities for transport and communications development. An indication has been given above of the difficulties generally involved in making cost-benefit analyses.

¹W. Owen, American Economic Review, Papers and Proceedings, Vol. 52, 1962, p. 413.

When this is done on the village level, however, the rationality of such evaluations markedly increases.

At this point, it may be appropriate to return to the question of which villages ought to receive the limited funds available. Although no definite answers can be given, we can present a few hypotheses and a different perspective.

C. Developing a Model

There is considerable value in trying to develop a generalized model of the growth process, which might be modified to apply to a given county or region within a country. To evaluate transport plans in developing countries, the Harvard Transportation and Economic Development Program is currently developing a model to "evaluate, for particular combinations of economic and geographic conditions (i.e., a country), alternative transportation plans and the associated long-term investment requirements. The transportation plan will include all modes of transport and will specify the locational characteristics, the particular technology (e.g., type of highway pavement), the time schedule of investments and expenditures, as well as availability dates for additions to the transport network. The study is restricted to freight movements between major resource, production and consumption centers. Transport movements within urban areas and passenger transport are not explicitly considered, though they are reflected as part of general consumer demand."¹

¹B.V. Martin and C.B. Warder "Transportation Planning in Developing Countries", Traffic Quarterly, January, 1965, pp. 59-75. The Harvard Transportation and Economic Development Program is a seminar and research project directed by Professor John R. Meyer, Harvard University, and financed by a research grant from The Brookings Institution, Washington, D.C.

Models of this type can become quite sophisticated, but here, for the sake of simplicity, it may be assumed that road construction would generally follow current and projected trade routes, with urban areas as focal points. It might also be assumed that communication growth would be patterned in such a way that heaviest concentration is in those areas surrounding urban centers and that coverage falls off in the more distant or more sparsely populated areas. A logical reason for continuing this pattern of coverage is the greater ease of extending the existing road network within a country as the interest in and need for mobility increases due to mass media exposure.

The extension of communications facilities radially from urban centers, however, may not foster optimal development. The Turkish survey (see Chapter II), for instance, provided some unexpected results. It was found, in looking at political party organization in the villages, that

If we look at the village's distance from the nearest urban center with over 50,000 population, we uncover a consistent and somewhat surprising relationship. The villages most likely to have been organized were neither those closest to the cities nor those furthest away. Instead, those villages intermediate in distance from the nearest city - between fifty and one hundred kilometers from it - displayed the greatest degree of political organization. Seventy per cent of those resident in a village 20-49 kilometers from such a city had a party cell in their community, and only 55% of those living 100 or more kilometers away had village party organizations. But 76% of those in villages between 50 and 99 kilometers from the city had party units in their villages. (The group of villages 0-19 kilometers from the nearest city was dropped because it included too few respondents.)

It was also found that

This same curvilinear relationship between urban proximity and various indicators of village modernity, progress, initiative - call it what you will - is frequently found in our data. It suggests, perhaps, that there is an optimal distance from the city in terms of modernizing influences. Too far away and urban influences are not disseminated. Too close and urban suction effects may tend to occur, drawing away village youth and leadership and reducing village cohesion and incentives. In any event, with regard to political organization as well as many other aspects of village social life, villages intermediate in distance from the nearest sizeable city seem to display the greatest vitality.¹

It is apparent that maximal benefits might be realized by concentrating investment in these villages which could then serve by means of the demonstration effect to diffuse the benefits of modernization to neighboring villages. For this purpose, investment in more communications equipment may not be necessary. For example, an analysis of a report on the impact of an extension program on cotton cultivation practices in an area of India has indicated that

if the evidence in reflecting the impact of the extension project is ambiguous, the evidence of the impact of word of mouth communications is overwhelming. This diffusion is relatively rapid within villages. Between villages, in this study, the information diffused at roughly 27 miles a year. (This fact has obvious implications for tactics in developing a set of communications nodes in a country to disseminate innovations...)²

¹F. W. Frey, "The Politicization of the Turkish Peasant: Selected Aspects", unpublished manuscript, M.I.T.

²E. S. Whitney Thompson, "A Linear Programming of Investment in Communications for Economic Development in India", unpublished manuscript, Political Science Department, M.I.T.

There is as yet, however, no evidence that the same suction effect holds for the more numerous smaller cities and urban areas, although it might take place on a reduced scale. Nevertheless, a gravity-feed type of communications density might be assumed in the area surrounding urban centers because of the greater difficulty in obtaining equipment, batteries and repairs at greater distances.

Considering that the alternative communications investment possibilities will normally be less expensive than the transport ones, and that certain areas may have more "vitality" than others, it should be possible to build a model of an optimal system for a given area in terms of transport and communications installations. The analysis could be based on two ranges like those described above and evaluated on the basis of where and when different improvements would be needed to optimize future overall development. The model would thus be evaluated over both space and time. The rate of development might then be gauged by means of the determination of some "lead time" - perhaps the length of time between the installation of the first radio in a village and the construction of a hard surfaced road within 2 miles of the village.

The value of communications as a substitute for transport will be greatest in the case of a long lead time, when the informational and educational needs of the people can be increasingly stimulated over a period of years by increasing the intensity of the communications coverage - perhaps stimulating the carrying out of other local projects and using local market facilities more efficiently - without increasing the need for mobility and the construction of roads.

Conversely, the utility of the substitution would be lowest when the lead time is shortest. When there is a rapidly growing need for transporting goods, roads will be built in any case. While development may ultimately result in the spread of both communication and transport throughout the country, the most economic means of achieving it may be found by programming for the delay period (the summation of the lead times) that will sustain the greatest overall rate of development. With this approach the model does, in fact, assume many of the aspects of a linear programming problem.

As a modest beginning for this sort of modelling, the choice has been made of an "average" situation for which equipment costs for telephone and radio can be determined. Of all the calculations involved in the cost-benefit analyses, communications equipment costs are the ones that can be set with the greatest generality, which is why they were chosen as the first to be determined.

The situation pictured is one of a village of about 300 dwellings which is located approximately 30 miles from a county capital. The village has no electricity. It is desired (1) to establish a single telephone link between the county capital and the village and (2) to furnish radio reception in each dwelling in the village. The description of the types of equipment which might be used to do this and of how much they cost will be found in Chapters III and IV. Although no direct evaluations of the benefits of installing this equipment in this particular situation will be attempted, in Chapter II we will look at a direct confrontation between the various effects of roads and radios on development in Turkey.

Chapter II. Comparing the Benefits of Roads and Radios: The Turkish Survey

Political integration, economic growth, educational advancement, and modernization of people's images, attitudes and behavior are important aspects of development. Central to all of them is communication. Information, ideas, laws, feelings, all must be shared in order for development to occur. Finding the most effective means for sharing them is therefore a critical problem. Reaching large numbers of people may require the use of mass media and of extensive transportation systems. But if radios are provided, will people listen to them? And, if they listen, what will they hear? If roads are constructed, will anyone use them? And, if used, with what effect? Must inhabitants actually commute to work in the capital before they can understand what being modern is really all about, or will they tend to set out upon their own to modernization themselves if the mass media provide the stimuli? The answers to this and derivative questions have important implications for resource allocation.

Finding ways to answer such questions is no easy task. Most of the quantitative or semi-quantitative attempts at getting at the relation of communication to development have taken either of two forms. One is a process in which the correlations among national statistics on literacy, level of mass media coverage, urbanization and other factors are examined for as many countries as have data. The second type involves

examination of, or experimentation in, one or more (perhaps many) villages in some developing countries. Both of these approaches contribute to general understanding of the development process, but the one gives the results in terms too general to be used as a practical guide for how to achieve development, and the other gives results which are often not even representative of the area in which the villages were located.

A. The Turkish Survey

Survey research seems to provide a means for reaching a middle ground between these two approaches. The data used here are from a 1962 national sample survey of Turkish peasants. In this survey, which is probably the largest single such survey in a developing country to date, 458 villages were examined. These villages were chosen to be representative of the whole country in terms of their region, distance from an urban center, and size. Interviewing teams went to each village, first, to gather descriptive data about the villages -- how many radios were in the village, how far was the nearest road, what sort of community buildings were there, how often did various government officials come, etc. -- and second, to interview a random sample of 15 to 16 villagers (a total of 6,636 villagers in all plus an additional sample of the village elite) to determine their knowledge and attitudes along a number of dimensions.¹

¹The scope and methods of the survey have been described in some detail in Frederick W. Frey, "Surveying Peasant Attitudes in Turkey", Public Opinion Quarterly, Vol. 27, Fall, 1963, pp. 335-355. See also F.W. Frey, The Mass Media and Rural Development in Turkey, Report No. 3, Rural Development Research Project, Center for International Studies, M.I.T., Cambridge, Mass., January 28, 1966, and the other reports in that series.

The data presented in this paper will give an idea of the flexibility possible when survey research is used. The analysis of the data is designed to compare the effects of two potentially causal factors in modernization: transport and communication. First, the respondents from all the villages in the survey will be examined to see what the general trends are. Then, those villages which rate exceptionally high or low on either transport facilities or communication facilities or both will be examined. The basis for judging the modernity of the respondents will be their rating on a series of indices which were constructed from questions on the survey's interviewing schedule.

Twenty-three indices will be used in this paper. They have been divided into five general categories -- transport/communication indices, economic, personal, social, and political. The name of each index is roughly descriptive of what it is trying to measure. Governmental Contact, for example, portrays the frequency of visits to the village by selected government officials: the county prefect or district director, military personnel, police or gendarmes, tax collector, educational officials, agricultural agents, health officials, and postal workers. This type of index is based on information descriptive of a village as a whole and is therefore common to all the respondents from a given village. Most of the indices, however, rate the respondents themselves. Subjective Poverty (-), for instance, (which is inversely stated, i.e., the higher the score the lower the subjective poverty) summarizes the answers to three deprivational

questions: had the respondent's family gone hungry for several days in the past year, had it run out of fuel in the past year, and did it suffer from the cold because of lack of clothing during the past year. The personal, social and political indices attempt to rate attitudes and cognitions important to development. All of the indices have been described in the appendix to this chapter.

Survey correlational data across villages have been presented in Tables 1 and 2. The correlation between two variables is simply a measure of the extent to which a given increase in one of the variables is associated with a proportional increase in the other variable. Normally it is not possible to infer that the increase in one of the variables caused the increase in the other. If one of the variables (the independent one) however, is in theory manipulable and its changing induces a change in the second (dependent) variable, then there is some justification for believing the relationship to be one of potential causality. This may not be so, naturally, if the theory is faulty. The independent variable may have been misused for the dependent variable, and the direction of causality may in fact be the reverse of that stated. Another reason for questioning the conclusion of causality is that the relationship may be spurious in that a third variable (or more) may be acting on it. This problem will be dealt with below.

In Table 1 columns (1) and (3) give the correlations, separately, of two independent, presumably causal, variables with each of the other indices. These two indices are Village Physical Isolation (-) and Village Mass Media Access. Village Physical Isolation (-) summarizes the physical isolation of a village in

Table 1. Correlations, Partial Correlations and Multiple Correlations of Village Physical Isolation (-) and Village Mass Media Access with other Indices of Modernity.

N. B.

- (1) The correlation of Village Physical Isolation (-) with _____ is (1).
- (2) The partial correlation, controlling for Village Mass Media Access, of Village Physical Isolation (-) with _____ is (2).
- (3) The correlation of Village Mass Media Access with _____ is (3).
- (4) The partial correlation, controlling for Village Physical Isolation (-), of Village Mass Media Access with _____ is (4).
- (5) The multiple correlation of Village Physical Isolation (-) and Village Mass Media Access with _____ is (5).

	Coefficients				
	(1)	(2)	(5)	(3)	(4)
Indices					
<u>Transport/Communication</u>					
1. Village Physical Isolation (-)	-	-	-	.45	-
2. Village Mass Media Access	.45	-	-	-	-
3. Geographical Mobility	.20	.13	.23	.19	.11
4. Mass Media Exposure	.13	.01	.27	.27	.24
5. Governmental Contact	.21	.07	.35	.34	.28

Indices	Coefficients				
	(1)	(2)	(3)	(4)	
			(5)		
<hr/>					
Economic					
<hr/>					
6. Subjective Poverty (-)	.10	.01		.20	.17
			.20		
<hr/>					
7. Village Establishments	.14	-.09		.47	.46
			.48		
<hr/>					
8. Village Social Services	.44	.20		.70	.63
			.71		
<hr/>					
9. Use of Govt. Agric. Services	.04	.02		.64	.02
			.05		
<hr/>					
<hr/>					
Personal					
<hr/>					
10. Propensity to Innovate	.01	-.03		.09	.10
			.10		
<hr/>					
11. Perceived Conc. of Values	.09	.01		.18	.16
			.18		
<hr/>					
12. Perceived Pos. Dir. of Change	.04	.00		.08	.07
			.08		
<hr/>					
13. Personal Don't Knows	-.05	.00		-.14	-.13
			.14		
<hr/>					
14. Community Don't Knows	-.02	-.00		-.04	-.03
			.04		
<hr/>					

	Coefficients				
	(1)	(2)	(3)	(4)	
			(5)		
Indices					
Social					
15. Tolerance of Deviance	.08	.02	.14	.12	.14
16. Religious Strictness	-.02	.01	-.06	-.06	.06
17. Positive Urban Image	-.03	-.05	.03	.05	.1
18. Direct Interpersonal Comm.	.04	-.00	.09	.08	.09
Political					
19. Personal Political Efficacy	-.01	-.02	.01	.02	.02
20. Political Empathy	-.01	-.03	.04	.05	.05
21. Politicization	.07	.02	.12	.10	.12
22. Social Wants	-.01	-.05	.07	.08	.08
23. Communal Responsibility	.06	-.02	.17	.16	.17

terms of its distance from the nearest regularly traveled road, railroad station, county center, and city over 50,000. The last three distances were measured in terms of travel time by the most common means of transport for making the trip. Also included in the index was the number of months the village was closed in by the weather. The index is inversely stated -- that is, the greater the score the less the presumed isolation. Village Mass Media Access portrays the availability in a village of the three main mass media -- newspaper, radio and cinema. This is not the same as individual exposure to these mass media, as expressed in Mass Media Exposure.

It can be seen from column (1) that Village Isolation (-) is correlated at the .20 level with Geographical Mobility and at the .21 level with Governmental Contact. As the latter two indices are measures of travel to and from the village, it is not surprising that there is an association between the village's isolation on the one hand and travel to and from it on the other. What is surprising is that the relationship is not greater than it is. It can be seen in column (3), moreover, that the correlation of Media Access with the two indices is nearly the same for one (.19 for Geographical Mobility) and greater for the other (.34 for Governmental Contact). It should be noted, however, that the substantive differences between the two independent indices may be due to the artifact of one (Media) being better measured than the other (Isolation).

From these results alone no conclusion can be drawn as to the relative benefits of the two independent variables because

of the nasty complicating factor that they are correlated with each other at the .45 level. Thus, perhaps a village's being less isolated means that it gets more of the media and this in turn increases travel. In other words a causal chain can be hypothesized with one of the factors as an intervening variable. One way of seeing whether and which one of the variables is less likely to be causal is by the use of partial correlations. Partial correlations take the simple correlation between two variables and allow for the effects of a third variable which is related to the first two. If the original correlation falls to or near .00 when the effect of the third variable is partialled out, this is evidence that the original presumed relation was spurious. In column (3) are the partial correlations of Village Isolation (-), controlling for Media Access, with each of the other indices. In column (4) are the partial correlations of Media Access, controlling for Village Isolation, with each of the other indices.

The results, observable in the table, are that the relation of each of the independent variables with Geographical Mobility drops about the same amount when the effect of the other independent variable is controlled for. Assuming that no further variable is working as a causal factor, it appears that the two independent variables have separate and approximately equal effects on Geographical Mobility. This was not the case for Governmental Contact, however, as the degree of association with Village Isolation (-) fell from .21 to .07 when the effect of Media Access was partialled out, but the coefficient fell only from .34 to .28 when the effect of isolation was partialled out of the relation with media access.

By following this procedure of comparing correlations and partial correlations for the independent factors with each of the other variables, it emerges that the correlations of Media Access with the other indices, while not high in absolute terms, are almost always higher than those of Village Isolation and, when controlling for the other independent variable, the coefficients with the isolation factor fall nearly to zero or go lower, whereas the coefficients with the media index remain nearly unchanged (some, in fact, go slightly higher due to computational rounding off). The coefficients for Communal Responsibility, for example, fall from .06 to -.02 for the former but only from .17 to .16 for the latter. Likewise, Politicization falls from .07 to .02 for the one but only from .12 to .10 for the other.

One further aspect of the relationship of the independent factors to the other variables can be investigated when the simple correlations among them are known. This is the effect of the two factors acting together on a third variable. This relationship is represented mathematically by the multiple correlation coefficient. The coefficient expresses the added amount that one of the factors contributes to the relation between the other factor and a dependent variable, after allowing for the degree of association between the two factors themselves. The multiple correlation of Village Physical Isolation and Village Mass Media Access with each of the other indices is given in column (5). The results are that there is very little increase in the coefficient for the isolation and media factors taken together over the coefficient for the media factor (column 3) alone. The inference which can be drawn from this is that, based on almost all the indices used,

there is very little point in both decreasing a village's isolation and increasing its mass media access in order to make the villagers more modern (in terms of the dependent variables employed here) because hardly anything will be gained over simply increasing its mass media access alone.

The independent factors in Table 1 are considered to be potentially causal in relation to the other indices. In Table 2 the presumably independent factors do not as clearly warrant that assumption. They are examined here, nevertheless, because they represent an intermediate step in the sequence from the introduction of physically manipulable factors to the internalization of modern attitudes, thoughts and behavior. They make it possible to look at villagers who actually leave their villages on occasion and to see what those who use the mass media available to them are like. These two independent factors are measured by Geographical Mobility and Mass Media Exposure. Geographical Mobility summarizes the respondent's physical mobility in terms of how often he leaves the village, where he goes, whether he has visited the nearest city with a population of over 50,000, whether he was born in his village, etc. Mass Media Exposure summarizes the respondent's degree of exposure to the newspaper, the radio and the cinema. These three media, the only ones available to the peasant, are equally weighted.

What is apparent in Table 2 is that, on the whole, the pattern of relationship is analogous to that in Table 1. There is a higher correlation between media exposure and modern ratings on the other indices (column 3) than between geographical mobility

Table 2. Correlations, Partial Correlations and Multiple Correlations of Geographical Mobility and Mass Media Exposure with other Indices of Modernity.

N. B.

- (1) The correlation of Geographical Mobility with _____ is (1).
- (2) The partial correlation, controlling for Mass Media Exposure, of Geographical Mobility with _____ is (2).
- (3) The correlation of Mass Media Exposure with _____ is (3).
- (4) The partial correlation, controlling for Geographical Mobility, of Mass Media Exposure with _____ is (4).
- (5) The multiple correlation of Geographical Mobility and Mass Media Exposure with _____ is (5).

Indices	Coefficients				
	(1)	(2)	(5)	(3)	(4)
<u>Transport/Communication</u>					
1. Village Physical Isolation (-)	.20	.16	.21	.13	.05
2. Village Mass Media Access	.19	.09	.28	.27	.21
3. Geographical Mobility	-	-	-	.42	-
4. Mass Media Exposure	.42	-	-	-	-
5. Governmental Contact	.06	.01	.12	.12	.10

Indices	Coefficients				
	(1)	(2)	(5)	(3)	(4)
<u>Economic</u>					
6. Subjective Poverty (-)	.13	.04	.22	.22	.18
7. Village Establishments	.04	-.05	.22	.21	.21
8. Village Social Services	.16	.11	.18	.15	.09
9. Use of Govt. Agric. Services	.07	.04	.10	.09	.07
<u>Personal</u>					
10. Propensity to Innovate	.11	.02	.21	.21	.18
11. Perceived Conc. of Values	.05	.02	.08	.08	.07
12. Perceived Pos. Dir. of Change	.12	.05	.19	.18	.14
13. Personal Don't Knows	-.11	-.04	.18	-.18	-.15
14. Community Don't Knows	-.21	-.09	.33	-.32	-.26

Indices	Coefficients				
	(1)	(2)	(3)	(4)	
			(5)		
<u>Social</u>					
15. Tolerance of Deviance	.03	.01	.05	.05	.04
16. Religious Strictness	.05	.05	.05	.01	-.01
17. Positive Urban Image	-.01	-.03	.05	.04	.05
18. Direct Interpersonal Comm.	.25	.09	.43	.42	.36
<u>Political</u>					
19. Personal Political Efficacy	.16	.05	.28	.28	.24
20. Political Empathy	.20	.07	.34	.33	.28
21. Politicization	.28	.14	.41	.39	.31
22. Social Wants	.09	.02	.18	.18	.16
23. Communal Responsibility	.09	.00	.21	.21	.19

and modernity (column 1). For example, the former correlates .21 with Propensity to Innovate while the latter correlates at only the .11 level. Media exposure and mobility are themselves related with a coefficient of .42, however, so it is desirable to consider the partial correlations. It is found that after controlling for media exposure (column 2) the coefficients relating mobility and modernity are reduced considerably, whereas, after controlling for mobility, the association between media exposure and modernity remains relatively high. Thus, the correlation of Propensity to Innovate with mobility falls from .11 to .02 when account is taken of media exposure, but the coefficient relating propensity to innovate to media exposure falls only from .21 to .18 when controlled for mobility. Because mobility and media exposure are highly related, as village isolation and media access were in Table 1, their combined effect, expressed in the multiple correlation coefficients in column (5), is hardly more than the effect of media exposure alone (column 3).

B. Comparing the Benefits of Roads and Radios

The above analysis has been based on data from all of the villages in the survey, which are, in turn, designed to be representative of all of rural Turkey. Included in the analysis were some villages that were very isolated, others that were very accessible, and many in between. Some of the villages had much access to the mass media, the others ranged down to having none at all. The peasants interviewed from all of the villages were rated individually on the indices. The correlations of village isolation and village media access with each of the other indices

are derived from a method of computing coefficients which is based on drawing the best fitting straight line through the points plotted on a graph of isolation versus another index or media access versus another index. The partial correlations are derived from the same type of calculation with adjustment of the points being made for how the second interacting factor affects the results. The low correlations found between the independent factor and the scores on the other indices mean that the points on the graphs were considerably scattered. Villages that were very isolated had some peasants who were modern and others who were not. Or, most of the peasants from some very isolated villages were modern and most of those from other very isolated villages were not. These alternatives were possible for all villages no matter how isolated they were or how accessible the mass media were to them.

The correlational analysis has provided the general finding that increasing mass media accessibility seems more important for producing modernity than does reducing village isolation. What the correlational analysis cannot provide a conclusive answer to is the ultimate question of causality. The partial correlations showed that even after controlling for the effect of media access, there was a residual association between villages isolation and modernity. Surely, while there may be other independent factors at work which ought to be partialled out, it is desirable to seek a conclusive answer to the causal question. The survey data provide a way for attempting this.

By making a few simplifying assumptions it is possible to reduce the dimensions of the independent factors involved. Since

the major manipulable factor in reducing a village's physical isolation is the laying of a road near it, a working measure of village isolation can be its distance to the nearest good road. Because radio is the most prevalent and most easily extended of the mass media, it can serve as a measure of village mass media access. Village isolation and media access were correlated at the .45 level, so it is to be expected that most of the villages that were isolated had little media access, while most of those which were not isolated had better media access. With a survey as large as the one being used here, however, it can be hoped that there will be a certain number of deviant cases -- villages that were isolated but had good media access and villages that were not isolated but had poor media access. In terms of the reduced dimensions this becomes villages which are far from a road but have many radios and villages which are near a road but have no radios.

		<u>Number of Radios</u>			
		Many		One	0
		50+	20+	1	0
<u>Distance to Road (Km)</u>	Near (0-4)	20 (299)		8 (112)	13 (184)
	Far (15+)	8 (105)		9 (125)	14 (193)

Table 3. Survey Villages Classified by Distance to Nearest Road (Km) and Number of Radios.

Table 3 shows how the expected and the deviant cases fell. There were 20 villages which were both near (within 4 km. of) a road and had many (50 or more) radios per village. These villages had a total of 299 respondents. The largest village in this group had 20 respondents (sampling was in proportion to village population), the smallest had 9, and the average was 15.0 (average for all survey villages was 15.3). Fourteen villages were far (over 15 km.) from a road and had no radios. Of these, the largest had 19 respondents, the smallest 10, and the average 13.8. Thirteen villages (largest 19, smallest 9, average 14.2 respondents) were near a road but had no radios. Eight villages (16, 10, and 13.1) had many radios even though they were far from a road. The villages near (19, 9, and 14.0) and far (18, 10, and 13.9) from a road with one radio have also been included. The double lines signify all the other survey villages not considered here. In addition there were 14 villages which were near a road and had 20 to 49 radios which have not been included in the NEAR-MANY category in the tables below.

With the villages sorted out as in Table 3, it is possible to see how the respondents from the villages in each category rated on the various indices. The respondents will be rated low, medium or high on each index. Since each index is a numerical scale consisting of whole numbers from 0 through (at most) 9, the three ratings were established for each index by determining which two numbers on the scale most nearly divided all 6,636 survey respondents into three numerically equal groups. An individual's score on a given index thus places him in the low,

medium or high group. The categories in Table 3 can be compared on the basis of the percentage of respondents in each group for each category. For example, it will be possible to compare the percentage of villagers high on propensity to innovate who lived near a road but had no radios available with the percentage of villagers high on propensity to innovate who lived far from a road but had many radios available. These percentages compared to the results for the other two extreme conditions should provide further evidence as to which factor -- roads or radios -- is more likely causal of modernity.

The categories in Table 3 can be compared on the basis of the percentage of respondents in each group for each category. For example, in Table 4 are the results for Geographical Mobility.

		<u>Number of Radios</u>		
		MANY	ONE	0
<u>Distance to Road</u>	NEAR	47 38 15	23 52 15	26 49 26
	FAIR	26 51 23	16 48 36	17 40 43

Table 4. Percentages of Respondents in Each ROAD-RADIO Category Who were Low (lower left in each box), Medium, and High on Geographical Mobility.

In order to simplify presentation, however, only the percentage of respondents in each category who rated high on an index will be given. Table 4 is thus reduced to Table 5.

Distance to Road	<u>Number of Radios</u>		
	MANY	ONE	0
NEAR	47	23	26
FAR	26	16	17

Table 5. Percentage of Respondents in Each ROAD-RADIO Category Who Were High on Geographical Mobility.

Similar data are presented for all of the indices in Table 6. While there is some loss of information by omission of the low and medium groups, this has not seemed to affect the conclusions to be drawn from the data.

For many of the indices a box has been added which indicates the percentage of respondents in the whole survey who rated high on those indices. These percentages were computed, however, on the basis of the number of respondents who were rated on an index, not on the total number of survey respondents. To be comparable with the percentages in the other boxes, therefore, only those indices which had nearly 100% of possible respondents rated in the extreme conditions have had the extra box added. The extent of the deviation of the percentages in the extreme boxes from the percentage in the box for all villagers for a given index is indicative of the sensitivity of the index to the presence and absence of radios and to the proximity of a decent road.

Table 6. Percentage of Respondents in Each ROAD-RADIO Category Who Were High on Each Index

Transport/Communication

	MANY	ONE	0	
1. Villager Physical Isolation (-) NEAR	64	65	34	
FAR	24	0	0	
2. Village Mass Media Access	97	0	0	ALL
	91	0	0	34
3. Geographical Mobility	47	23	26	
	26	16	17	32
4. Mass Media Exposure	52	18	16	
	47	16	2	32
5. Governmental Contact	79	12	10	
	36	32	12	

Economics

6. Subjective Poverty (-)	48	17	36	34
	30	20	23	
7. Village Establishments	62	0	0	22
	24	0	0	
8. Village Social Services	60	16	0	25
	25	0	0	
9. Use of Govt. Agric. Services	13	12	9	
	19	14	14	

Personal

10. Propensity to Innovate

NEAR
FAR

MANY	ONE	0	ALL
18	12	14	12
20	6	3	

11. Perceived Conc. of Values

58	39	36	43
36	45	22	

12. Perceived Pos. Dir. of Change

38	29	35	53
39	23	25	

13. Personal Don't Knows

12	15	18	12
11	18	36	

14. Community Don't Knows

22	21	22	20
16	20	33	

Social

15. Tolerance of Deviance

31	30	29
21	32	15

16. Religious Strictness

20	26	32
16	36	48

17. Positive Urban Image

12	15	17
18	12	17

18. Direct Interpersonal Comm.

43	17	17
30	36	15

Political

		MANY	ONE	0	ALL
19. Personal Political Efficacy	NEAR	25	29	23	29
	FAR	34	24	24	
20. Political Empathy		18	25	15	22
		28	21	14	
21. Politicization		34	24	20	26
		41	25	13	
22. Social Wants		60	54	64	54
		59	52	37	
23. Communal Responsibility		47	32	21	
		42	24	13	

Contrasts in Village Life at Either End of the Diagonals

Taken as a whole, the results presented here give a graphic account of the state of the villages at the extremes of road and radio activity. Analyzing the results for Geographical Mobility will illustrate how the conclusions which follow were drawn. Table 5 (or see Table 6) shows that, as might be expected, of the four extreme conditions of road and radio availability, the largest percentage of highly mobile villagers (47%) was found among the villagers who lived near a road and had many radios, while the smallest percentage (17%) was found among those who lived far from a road and had no radios at all in their villages. Most interesting, however, the percentage of villagers who were highly mobile was the same (26%) for those living near a road but having no radios as for villagers who lived far from a road but had many radios. Thus, roads and radios had equal effect in causing mobility.

It is enlightening to compare the villages at either end of the diagonal -- those with no radios that are far from a road and those that have many radios and are near a road -- for all of the indices. One of the striking differences which appears between the two is that the respondents living in villages which have neither a nearby road nor any radios are clearly hardly involved, either cognitively or physically, in communal or extra-communal activity.

In general, village life for the most isolated villagers is traditional, static and family-centered. Having no roads or radios, the villagers have very little contact with the outside world. They rarely leave the village, and agricultural agents, postal workers, and other government officials seldom come to see them. It is unlikely that the villages they inhabit have such amenities as coffee houses, clinics, or schools. They do not in fact meet very often with villagers who are not members of their own family, as shown by the Direct Interpersonal Communication index, and, as a result, have little knowledge of what others in the village are doing. Consequently, there is little feeling of a need to work together for village improvement.

As for personal lives of the villagers in this category, there is not much inclination to be the first in the village to try a new practice, nor would these people be likely to accept such a suggestion from a son. They view non-traditional religious practices with great isfavor. In addition, their involvement in political life is at a low level. For example, they are not likely to even be able to name the main political parties.

While this is accurate as a general description of such traditional village life, one most important caveat must be added. This is the finding that even in these villages (that were far from a road and had no radios) there was always a range from less modern to more modern respondents, as shown by the per village breakdown from which the percentages here were computed. Thus, because recent history has shown that once development starts there is usually no turning back, the small but existing group of more modern respondents in each village may be viewed as embodying the vanguard of the forces for transition in those villages.

The respondents on the other end of the diagonal, however -- those living in villages with many radios and a nearby road -- generally rated high on all of these indicators of modernity. Among these villagers there was a considerable amount of knowledge about life in their own village, and the most pronounced propensity to innovate. There was also more tolerance of deviance and less strictness in religious matters. While power and wealth were perceived as being in a few hands, this situation was seen as changing for the better. At the same time, the living standard in terms of the basic necessities of food, clothing, and fuel was generally higher than that of the villagers in any other category dealt with in this paper. Furthermore, the villages inhabited by the respondents in this category had more common establishments such as coffee houses and stores, and facilities such as clinics, schools, and postal service than other villages.

These villagers were also the ones who had the greatest overall attitude of communal responsibility. That they were also more than just community-centered, however, is shown by the fact that travel to and from their villages was at a comparatively high level and that there was significant participation in the political process as well. Nevertheless, they did not have an excessively positive view of urban life.

Radios and the Fostering of "Vitality"

The major finding of this study, however, is: For every one of the measures which have been employed, villages which were far from a road but had many radios were nearly as or more modern than the villages which were both near a road and had many radios, whereas the villages which were near a road but had no radios were substantially less modern. Even from the one factor with which roads are assumed to be most closely associated -- travel to and from the villages -- it was found that radios were as effective as roads. The peasants living in villages which were distant from a road but which had many radios were just as mobile as those who lived in villages which were near a road but lacked radios. More strikingly, there was greater travel by government officials to villages which were far from a road (fifteen or more kilometers) but had many radios than there was to villages near a road (up to four kilometers) but which lacked radios. This was true even though the former were more isolated than the latter, as shown by the Village Physical Isolation index, when measured by criteria other than proximity to a road. Clearly, travel to

and from these villages was not determined on the basis of ease of transport alone. Rather it appears that having radios served as a direct substitute for the presence of roads.

The ability of the villagers far from a road but with many radios to be significantly mobile, and, perhaps even more so, their ability to attract government officials to their isolated locations is indicative of a certain vital quality that literally makes them peasants in motion toward modernity. These peasants are relatively poor -- their families may have gone hungry for several days during the past year, many of them ran out of fuel and suffered from the cold due to lack of clothing, but they seem to be doing whatever is possible to overcome their physical discomforts. They have built a number of common establishments in their villages such as a coffee house, a fountain, a guest room, a store and an artisan's establishment. In addition they are quite likely to have a doctor, a midwife, a teacher, a veterinarian, a government agricultural agent in their village. And they, even more than the villagers who had many radios but lived near a road, tended to have used government credit and to have received agricultural supplies such as seed and fertilizer from the government.

That these are truly villagers in transition is shown by their personal attitudes and knowledge. Although relatively poor, they, more than any other group, feel that things will become better during their lifetime. This is because they are helping to make it so. They are most likely of all to be willing to try a new and useful way of working and to side with the "modern" group in the village when there is a problem of

innovational conflict. They tend to meet and talk with other villagers and are consequently most well-informed of what goes on in their village. Thus they are least likely to answer "Don't know" when asked what the main village problem is, if there are people who introduce new ways into the village, to whom most villagers look for farming leadership, or if there has been a recent village project. In addition they have the least problem in deciding such questions as how many children they would like to have, what their main personal wish is, and what they would do with about 100 dollars. If modernity is measured in terms of development of individuals, these villagers surely are becoming modern.

The sense of personal involvement and accomplishment of these villagers is expressed also in the political sphere. They quite clearly have more familiarity with and knowledge of the political process than any other group. They have little difficulty in expressing what they would do if they were Prime Minister, county prefect, or headman of their village. Moreover, they feel relatively free to discuss their problems with the actual village leaders and have a general feeling of control over their own future. Thus, while they believe on the whole that it is important for the government to provide more seed and fertilizer, more agricultural credit, and more irrigation facilities, and to improve village mosques and schools, they are not inclined to place the burden of satisfying even these practical needs wholly on the government. Instead, they see such improvements as being the responsibility primarily of themselves or of both the government and themselves working jointly.

Almost none of these statements can be made about the villagers who have good access to roads but have no radios. They tend to be somewhat poorer than the inhabitants of villages far from a road but with many radios. This condition remains unrelieved because of the almost total lack of the establishments and social services which might act as a focus for communal enterprise and improvement. These villagers have the least contact of all with government personnel and therefore are least likely to make use of the government's agricultural services, which might be of direct benefit to them.

What comes through about these villagers is that they are the ones most susceptible to the frustration caused by unfulfilled rising expectations. Yes, they want improvement -- improved roads, more seed and fertilizer, better mosques and schools, but they more than any other group want the government to provide it. They clearly feel that it is much more the government's responsibility to provide all these things than it is the village's or even that of the government and village working together.

Partly the impasse for these villagers may be that they have not become very involved in the political process at any level. They are the least likely, for example, to perceive themselves as being able to discuss problems with their village leaders; they for the most part do not even know the names of the national political parties; and they are stymied by such simple questions as what they would do if they were Prime Minister, county prefect or, even, headman of their village.

All this is not to say that no progress has been made in these villages. On the whole they rate higher than the villages with neither roads nor radios, but their level of modernity falls far short of that of the villages which had many radios but no nearby road. The presence of radios, therefore, is demonstrably more highly associated than is the presence of roads with the existence of attitudes generally considered to be prerequisites for overall development. Further, this evidence gives strong support to the presumption that the relation is a causal one -- i.e., that the mass media, unlike transport facilities, tend to free villagers' cognitive processes so that they are able to overcome even such obstacles as physical isolation by working both with other villagers and with representatives of the national government. The mass media thus create a great potential for development.

Further evidence as to the effects of having radios is derived from the ratings of villages near or far from a road which have a single radio. While the patterns are not completely consistent, it appears that whether near a road or far from a road the villages with even one radio tend to be somewhat more modern than the villages at the corresponding distance to a road which have no radio at all. Only 6% of the villages in the survey had one radio, whereas 25% had two to four radios and another 22% had five to nine radios. It can be inferred that having one radio in a village is an unstable situation. Perhaps a single radio may be liable to ownership or control by one person, which leads to other villagers wanting to reduce the monopoly by

acquiring additional sets. In any case it does seem that even having one radio makes a difference in the villagers' attitudes toward modernity.

The alternative hypothesis to the one suggested here about the causal relationship between the presence of radios and modernity is that villages which already have modern attitudes buy radios, whereas villages normally do not have control over where roads are built. The counter to this alternative hypothesis, however, is that many other (longitudinal) studies have shown that road introduction does change a village. Since that is the case, radios must be causal also.

C. Summary of Results

The major conclusions which can be drawn from this research, then, are:

(1) that the mass media were highly effective in inducing in the villagers many of the attitudes now considered essential for development,

(2) that radios alone were far more effective in inducing these attitudes than was proximity to a road alone,

(3) that the mass media did not inculcate in the villagers the ostensibly harmful attitudes which some have feared they might, and

(4) that these results give strong support to the presumption that the relation between the presence of the mass media and of modern attitudes is one of cause and effect.

Some of the more specific conclusions may be summarized as follows:

a. Those who lived in villages which were far from a road but had many radios were just as mobile as those who lived in villages that were near a road but had no radios. In addition, travel by government officials to the former villages was greater than to the latter.

b. Those in villages far from a road but with many radios were more community-centered than those in villages near a road but with no radios; they had more knowledge about what went on in their village and were more willing to undertake community projects. While more actively involved in the national political process, the villages with radio were less likely to think of relying on the national government for village development than were the latter.

c. The villages with many radios did not necessarily have a higher level of subsistence, but they had far more services and establishments.

d. The presence of radios did not have the effect of inciting villagers to want to move to the city.

Appendix to Chapter II
Description of Indices

Transport/Communication

1. Village Physical Isolation (-) summarizes the physical isolation of the village in terms of the distance from the nearest regularly traveled road, railroad station, county center, and city over 50,000. The last three distances were measured in terms of travel time by the most common means of transport for making the trip. Also included in the index was the number of months the village was closed in by the weather. The index is inversely expressed -- that is, the greater the score the less the presumed isolation.
2. Village Mass Media Access portrays the availability in the village of the three main mass media -- newspaper, radio and cinema. This is not the same as individual exposure to these mass media, as expressed in Mass Media Exposure.
3. Geographical Mobility summarizes the respondent's physical mobility: how often he leaves the village, where he goes, whether he has visited the nearest city with a population over 50,000, whether he was born in his village, etc.
4. Mass Media Exposure summarizes the respondent's degree of exposure to the newspaper, the radio and the cinema. These three media, the only major media available to the peasant, are equally weighted.
5. Governmental Contact portrays the frequency of visits to the village by selected government officials: the county prefect or district director, military personnel, police or gendarmes, tax collector, educational officials, agricultural agents, health officials, and postal workers. This is an index of the village's contact, not necessarily that of the individual villager.

Economic

6. Subjective Poverty (-) summarizes the answers to three deprivational questions: had the respondent's family gone hungry for several days in the past year, had it run out of fuel in the past year, and did it suffer from the cold because of lack of clothing during the past year. The index is inversely expressed; i.e., the higher the score the less the subjective poverty.
7. Village Establishments expresses the existence in the village of certain common establishments or facilities: a coffee house, fountain, guest room, store, and artisan's establishment.
8. Village Social Services displays the presence or absence in the village of twenty-four different social services such as: telephone, postal service, cinema, doctor, midwife, teacher, veterinarian, priest, agricultural agent, clinic, school, and evening courses.
9. Use of Government Agricultural Services displays the results of three questions asked of males only: had they ever consulted with a government agricultural agent, had they ever used government credit, and had they ever received agricultural supplies such as seed and fertilizer from the government. Higher score equals greater use of the specified services. (The inter-item correlations for this index are quite low, so its unidimensionality is very suspect.) Apparently, more "modern" peasants are more likely to consult with the agricultural extension agent, but less likely to use government credit or supplies (perhaps because of less need).

Personal

10. Propensity to Innovate is formed from the answers to three questions: would they be willing to be the first person in the village to try a new and useful way of working, would they accept the recommendation of a son of theirs concerning such a new and useful practice, and did they perceive innovative conflict in the village and side with the "modern" group.
11. Perceived Concentration of Values reveals the respondent's tendency to perceive wealth and power in his village as concentrated in one or a few hands.
12. Perceived Positive Direction of Change displays a summary of the respondent's answers to three questions: are wealth differences between families in the village getting larger or smaller, is the prestige of his family greater or less, and does he think that things will become better or worse for him during his lifetime. The index reveals the tendency to answer these questions optimistically.
13. Personal Don't Knows summarizes nine questions involving the personal opinions of the respondent and seemingly not dependent on his level of knowledge. The questions covered such matters as the desired number of children, their main personal wish, what they would do with 1,000 TL. (about 100 dollars), do they think things are going to get better or worse, do they believe in fortune tellers, how important it is to be happy, etc. A higher score indicates a higher tendency to answer "don't know" to these questions.
14. Community Don't Knows involved nine rather basic questions regarding the community. These questions included: what is the main village problem, are there people who introduce new ways into the village, to whom do most villagers look for farming leadership, are village wealth differences increasing, is the village influenced by outsiders, who is the most respected villager, has there been a recent village project, can the village handle its own problems, etc.

Social

15. Tolerance of Deviance is forced from six questions (three pairs) asking the respondent whether the sanction of "public criticism" should be invoked against three different types of mildly deviating persons (non-praying, gossiping, and wasteful). The question was asked separately with regard to each of the three behaviors for supposed male and female offenders.
16. Religious Strictness summarizes five questions asking whether the respondent considered various practices to be against his religion. The practices were: hanging pictures on the walls of his house, translating the Koran into Turkish, drinking alcoholic beverages, lending money at interest, and using drugs to keep from having children. Higher score equals greater strictness of religious interpretation.
17. Positive Urban Image summarizes the answers to eight questions about the lives of villagers who had migrated to the city: were they happier, financially better off, lonelier, better able to find opportunities for their children, more likely to become immoral, etc.
18. Direct Interpersonal Communication portrays the degree to which the respondent seems to be involved in direct interpersonal communication with other villagers. It is based on how frequently he visits the village coffee house or other meeting place (for males only), whether he knows everyone in the village, whether his friends are mainly relatives or not relatives, whether members of his household live in the city, etc. The index is different for males and females, so that inter-sex comparisons are impossible.

Political

19. Personal Political Efficacy summarizes four questions asking about the reaction of the respondent to a perceived injustice by the local and national governments, about his perceived ability to discuss his problems with village leaders, and about his general feeling of control over his future.
20. Political Empathy is formed from three questions asking the respondent what he would do if he were Prime Minister, County Prefect, and Headman of his village.
21. Politicization reflects the political knowledge and participation of the respondent as revealed through his voting and his knowledge of Turkey's main political parties. Since actual voting is involved and since the minimal voting age is 22 years, age differences between sub-groups affect the results.
22. Social Wants reflects the answers to questions of how important it was that the government do a number of things such as: improve village roads, provide more seed and fertilizer, improve village mosques, improve village schools, provide more agricultural credit, furnish more postal service, make more newspapers available, and provide more irrigation facilities.
23. Communal Responsibility summarizes five questions asking whether various projects such as school building, providing better drinking water, and improving village houses are primarily the responsibility of the government, the villagers, or both the government and the villagers working jointly.

Chapter III. Radio Usage and Equipment Costs

A. Radio Usage in Perspective

Radio is one of man's most powerful and pervasive communication media. For the developing countries broadcasting represents very close to an optimum means of mass communication. It can cover long distances and terrain which hamper distribution of other media. Once established a national broadcasting system is relatively inexpensive to maintain. It does not require the continuing heavy investments in foreign exchange required by other media such as newsprint, film and publishing materials. An initial investment for a radio transmitter is modest in comparison to a newspaper plant or publishing house.¹ Radio is effective even when the audience is illiterate. In fact, it can be used to combat illiteracy itself. It is the most rapid medium in reaching the recipient of a mass media message and the least expensive in production cost. Radio serves a broad spectrum of interests: information, enlightenment and entertainment. In most countries it is the medium most frequently run by the government, which thus is not opposed to developing radio as it might be to financing other media.

Many communications specialists in less advanced nations have enthusiastically acclaimed the possibilities of radio for their regions. For example, delegates to the UNESCO Conference

¹For a notable exception to this see "Rural Mimeo Newspapers," Reports and Papers on Mass Communication, No. 46, UNESCO, Paris, 1965.

on Developing Mass Media in Africa in 1962 predicted that "... radio was destined to play a particularly important role throughout the continent."¹ The conference urged that broadcasting not be considered a luxury, but a vital necessity in the development of the country. In Bangkok during 1960, participants in an earlier series of UNESCO meetings on Mass Media agreed they were "deeply conscious of the fact that radio is truly a medium of mass communication so powerful that some of its implications are almost frightening."² The UNESCO Report on "Mass Media in the Developing Countries" declared that "In attempting to accomplish in a matter of years a task which had been the work of centuries in the advanced countries, the underdeveloped regions cannot rely on the traditional means of education alone, but are turning to radio broadcasting which, like film and television, offers immense possibilities for instruction through the media of mass communication."³

Despite radio's promise for the world's developing areas and great expectation by the emerging countries that broadcasting would breach the elite-mass gap and become the primary means of reaching the rural populace, surprisingly little is materializing for the peasant. One of the communications specialists most optimistic about the development of radio, Wilbur Schramm, suggests that underdeveloped regions are making "impressive progress" in

¹ UNESCO, "Developing Mass Media in Africa," Reports and Papers on Mass Communication, No. 37, UNESCO, Paris, 1962, p. 24.

² UNESCO, "Developing Mass Media in Asia," Reports and Papers on Mass Communication, No. 30, UNESCO, Paris, 1960, p. 26.

³ UNESCO, "Mass Media in the Developing Countries: a UNESCO Report to the United Nations," Reports and Papers on Mass Communication, No. 33, UNESCO, Paris, 1961, p. 33.

meeting the UNESCO minimum of five radios per 100 population.¹ He predicts that the "rate of growth in radio will take both Asia and Africa over the UNESCO minimum standards within a few years."² Yet, Schramm is quick to admit that radio remains chiefly an urban phenomenon. He points out that in India only one in ten receivers are in villages where four-fifths of the people live.³ Attributing this largely to a lack of electricity in rural areas, Schramm notes that "In more than one country a well-meant plan to extend the coverage of radio has failed simply because there was no one to recharge or replace a battery in an otherwise operable set." Ithiel Pool has observed that "Most developing countries have done something by way of developing village-oriented radio program and educational programs, but their efforts are small."⁴ Pool cites the Indian case as indicative of the low priority allocated to broadcasting by national planners.

¹Wilbur Schramm, The Role of Information in the Developing Countries (Stanford, California: Stanford University Press, 1964), p. 98.

²Schramm's prediction appears to be exceedingly optimistic. UNESCO figures, published in 1961 based on a 1960 survey, show less than one set per 100 persons in Afghanistan, Burma, Cambodia, India, Indonesia, Laos, Nepal, Pakistan, Thailand and Vietnam. The following had between one and four sets: Ceylon, China, Korea, Malaya, and the Philippines. It is considerably less for nearly all African countries, with few exceptions.

³Schramm, p. 101.

⁴Ithiel de Sola Pool, "The Mass Media and Politics in the Modernization Process," in Lucian W. Pye ed., Communications and Political Development (Princeton, New Jersey: Princeton University Press, 1963), p. 234.

Broadcasting can maximize its impact in less advanced countries at the earliest stages of national development and the modernization process. For it is during this period of development problems that broadcasting can overcome communications barriers in reaching the illiterate, serve as a strong force for national identity and integration, and provide an effective channel for the flow of information on development. Yet, radio appears to be a long way from this breakthrough to the rural masses that has been so consistently predicted. What can be done to achieve not only the UNESCO minimum, but to make it truly the rural medium it is so capable of being? To meet the current requirements of the underdeveloped countries alone and bring radio to each family would mean the provision of 350 million new sets or loudspeakers. Taking Asia as an example, numbers of receivers in 1960 ranged from 1.9 per thousand to 158 per thousand, the average being 22.6 per thousand persons, or a total of 37 million sets. This is well under UNESCO's five per hundred goal. Experts who attended the UNESCO Bangkok conference felt it would be reasonable to expect that the level of one set per family could be reached within 15 years, and the UNESCO minimum considerably before that time. Using UN population forecasts for Asia, this would mean about 90 million sets for a population of 1785 millions by 1965, and 442 million sets for a population of 2210 millions by 1975.¹ It is highly unlikely that Asia has come anywhere near the 1965 goal.

(In Taiwan, however, where electricity is available in almost every village, it is reported that some 600,000 radio

¹UNESCO, "Developing Mass Media in Asia," op. cit., p. 27.

sets are owned by 780,000 farm families. In addition, 19 out of 62 radio stations now sponsor, in cooperation with agricultural agencies, farm programs which are broadcast every day except Sunday. Radio is thus the cheapest and most effective means for reaching farmers in Taiwan.)¹

This section will consider in some detail three different types of radio systems which can be made available to rural inhabitants of developing countries. Community radio, individual or family radio listening, and wired radio systems each have advantages and disadvantages. Little effort has been made in the literature available to specify the distinctive attributes of each system or to make comparisons between them. A comparative analysis will be made here of transistor radios and wired radio systems currently being used in South Korea.

B. Community Radio Listening - UNESCO Radio Rural Forums

Radio Rural Forums

In any place where the receivers of mass media broadcasts are in short supply various types of community listening develop. This was true in the United States, for example, in the early days of television, when the home of the single set owner in a neighborhood was likely to be a place of congregation for watching television programs.

This has also been found to be the case in developing countries where there may be only one or a few radio sets in a village.

¹Y. K. Yang, Chief, Farmers' Service Division, Joint Commission on Rural Reconstruction, Taipei, Taiwan, personal communication, letter, August 19, 1965.

The location of these sets proves a meeting-ground for listening. For Turkish villagers, for instance, the usual place of radio listening is (as a percentage of respondents):

- 22% Own House
- 41% Another House in Village
- 26% Corree-house, Guest room or Store
- 3% Elsewhere in Village
- 7% Outside Village¹

Listening to the radio either alone or in small groups in a headman's house or coffee shop has many benefits, as was shown in Chapter II. To derive an action-orientation from such listening, however, requires another ingredient. This is organization.

The major effort which has been made to test the value of organized community radio listening in developing countries has been sponsored by UNESCO. Based on a successful experiment in Canada,² a program of community listening was tested in 1956 in 150 villages in India.³ Because of the success of the initial experiment, the Indian Government has tried to make more radio sets available to its approximately 550,000 villages. A special subsidy program has been used to do this, under which 145,000 sets have already been supplied and plans have been laid to make available another 46,000 sets. From these radios, 10,000 have been used to establish Rural Forums. The current target is to estab-

¹F. W. Frey, "Rural Development Research Project," Preliminary Report, Political Science Department, M.I.T.

²"Canada's Farm Radio Forum," UNESCO, Paris, 1954.

³"An Indian Experiment in Farm Radio Forums," UNESCO, Paris, 1959.

lish 25,000 forums by about the end of the Third Plan period.¹

Because of the success of the Indian enterprise, UNESCO has recently begun to extend Radio Rural Forums to African countries. One such project has been in Togo.

Togo

Radio Togo's "Radio Rurale" started in August, 1964, and consists of three parts:

First, every evening in two local languages and in French, programs are broadcast on topics of national development-Agriculture, Health, Education, Social Reform, and Planning. These programs are planned and prepared by a special committee consisting of representatives of each of the ministries and departments concerned and Radio Togo's program personnel. The same committee periodically reviews the progress made and, in the light of experience gained, plans future action.

Second, rural forums have been organized (initially in 152 villages) throughout the country. The forums have been described as listening-cum-discussion-cum-action groups of twenty volunteer members who represent a cross-section of the village community. They elect their group-leader or "animateur" who is in charge of keeping the radio receiver (donated by UNESCO to Togo), who conducts the group listening and group discussions, and who records the group's views and suggestions on various topics. The club meets every evening to listen to the programs; efforts are made to understand fully their content and then discussions are held about how the knowledge and

¹"Radio Broadcasting Serve Rural Development," Reports and Papers on Mass Communication, No. 48, UNESCO, Paris, 1965.

information gained from the broadcasts could best be practically applied to local conditions. Thus on listening to a health program, the members may decide to take suitable preventive measures for their families and for the village as a whole; they may decide to undertake a common project (e.g. build a road) or they may simply use the information for their individual professional or personal benefit.

The third part is the "feed-back"--the weekly reports which are received from each of the radio clubs. These not only assure the radio station that the programs are heard satisfactorily, but present the opinions and reactions of the groups (it is made clear that the weekly report must reflect the opinion of the whole group). Thus, the radio and the planning authorities are continuously in touch with the felt needs of the villages, which helps them in making their programs increasingly useful and practical.

It can be seen that the group leader plays as important role in the success of Radio Rurale. These are young men who are literate and capable of conducting group listening and discussions in a positive, constructive manner. They are not paid for this service, but all materials they require (including pre-paid postal envelopes) are supplied by the radio station. Moreover, they are given a short training course in manipulation of the radio sets, the organization of listening groups and the filing of reports. A radio school, also opened in 1964, trains both the group leaders and program producers.

During most of 1965, the project was reported to have worked well. Over 80% of the sets were reported to have given satisfactory performances and over 70% of the reports were regularly received.

The Government of Togo has therefore purchased 650 new sets, and radio clubs are planned for 800 villages before the end of 1965. (There are approximately 3200 villages in Togo but only about 1000 of them have more than 400-500 inhabitants.)¹

Ghana

Another pilot program has already been carried out in Ghana. This project was set up by the Government of Ghana in cooperation with UNESCO and the External Aid Office of the Government of Canada. UNESCO provided the Government of Ghana (Radio and Television Corporation) with \$10,000; Canada supplied two technical experts--an experienced rural broadcaster and a rural sociologist. All other staff, transportation, equipment and supplies were provided by the Government of Ghana, chiefly by the Ghana Radio and Television Corporation.

Eighty villages were selected by the sociologist to participate in the Rural Forums. Their selection was based on census data which permitted random selection representative of the Eastern region of Ghana. This region had been chosen as being typical in terms of rural life and agricultural production. It is a region where the major language--which is Akan (Twi)--could be used for all broadcasts and discussions.

The 80 villages chosen were divided into four categories. Type A were 20 villages in which one forum was organized per village. Type B were 20 villages in each of which two forums were organized. Type C were 20 villages where a radio was supplied

¹The above information was supplied by R. M. Marathe, UNESCO Expert Adviser in Togo, in a personal communication, letter, August 25, 1965.

but no formal listening group was organized; and Type D were 20 villages in which no radio was supplied and no listening group was organized. Both Types C and D thus served as controls. The average population of the villages was Type A - 1,147, B - 1,683, C - 1,178, and D - 583.

The series of broadcasts consisted of one program a week for 20 weeks, starting in December 1964. They were aired on Sunday evenings from 6:15-6:45. The radios were used only during the actual broadcast time, and the sets were constructed so that only transmissions from Radio Ghana could be received on them.

Each forum consisted of 20 members of whom 10 were to be males primarily engaged in farming and with little or no formal education, 5 were to be males primarily engaged in non-farm work and with formal education to the Middle I level or beyond, and 5 were to be females engaged in farming activities and with little or no formal education. Forum members were chosen by village leaders on this basis. Each forum had a chairman and a secretary. Many of these forum officers volunteered their services, but others were requested to serve by the village chief or by Radio Ghana representatives. The secretary would summarize his group's discussion, record attendance and other information on a prepared form, and return these items to the project headquarters. "Feedback" broadcasts were based on this information.

On the average each forum met for 15 of the 20 broadcasts. About half of the forums met for 14-17 broadcasts and about one quarter met for each of 18-20 times and 7-13 times. The number of meetings seemed to be positively related to the service re-

ceived from the project headquarters. Attendance data showed that perhaps one-quarter of the members of all the forums attended all the meetings and approximately another fifty percent attended more than half (but not all) the meetings. Educated males (many of whom were secretaries) attended far more regularly than un-educated males, who in turn attended more regularly than the females.

The following were topics for broadcasts.

1. Farm Goals and Aims
2. Foreign Trade and the Farmer
3. Loans and Subsidies for Farmers
4. Education for the Farm Family
5. Careers in Rural Areas
6. Traditional Institutions in Educational Development
7. Marketing Our Crops
8. Keeping Quality High
9. Co-operatives
10. Safeguarding Our Health
11. Eat Your Way to Good Health
12. Family Budgeting
13. The Farmer as Citizen
14. Local Government
15. Self-Help Projects in Villages

During the two-week period subsequent to the last broadcast, a sample of 438 forum and non-forum members (depending on the type of village) was interviewed. It was found that for 10 of the 15 subject matter areas there was "evidence of the positive influence" of the forums. In an additional 3 subject areas the influence of a publicly available radio was found; that is, the knowledge shown by respondents from A, B and C-type villages was about equal and was greater than that shown by D-type vil-

lagers. Only for topics 10, Safeguarding Our Health, and 13, The Farmer as a Citizen, did the presence of radio with or without a forum seem to have caused no change. This was presumed to have been because of long-term efforts to reach all villagers by Social Welfare and other health officials with regard to the former and by local functionaries of the Convention People's Party for the latter. Examples in which the forums did have an effect are as follows.

For topic 1, Farm Goals and Aims, these percentages of respondents (by type of village) reported action to increase the production of crops, poultry or livestock within the preceding 6 months:

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>All</u>
60	53	42	35	49%

Keeping Quality High (topic 8) in terms of recent plans or action to improve methods of harvesting, storing, processing or transporting of crops, was reported by these percentages:

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>All</u>
27	24	8	13	20%

With regard to Co-operatives (topic 9), these percentages had joined a co-operative within the past 6 months:

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>All</u>
16	19	3	6	10%

The following percentages were able to name a co-operative started within the past 6 months in their own or another village:

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>All</u>
55	43	35	28	41%

Finally, the goal of putting money aside to meet future emergencies was advocated under topic 12, Family Budgeting. The percentages of villagers who said they were "now doing so" were:

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>All</u>
70	60	57	50	61%

In general this pilot project was found to be successful in light of its stated purpose of using radio to inform, educate and stimulate self-help programs among rural organized listening and discussion groups. In fact, the major problem was reported to be providing adequate follow-up help for requests for help and information which were stimulated by the forums.

Before the 20 programs had been completed (in March 1965), the Government of Ghana decided to extend the forums to "hundreds" of villages, because of its demonstrated effectiveness in interesting and informing rural people. In addition, although forums were originally established in only 40 villages, it is estimated that approximately 60,000 people listened to the broadcasts over Radio Ghana.¹

The Radio Rural Forums have thus been as successful in Africa as in Asia. One indication of the success they had in India was a measure of the "gains in knowledge" of the participating villages. It was reported that "on an 18-point scale that

¹The above description was in part supplied by Dr. Helen C. Abell, Professor of Sociology, Department of Extension Education, Ontario Agricultural College, Guelph, Ontario, Canada, in a personal communication, letter, September 9, 1965, and in part drawn from Dr. Abell's summary of her evaluation of the Ghana Farm Radio Forum Project, which was submitted to UNESCO in June, 1966. The latter was quoted with the permission of UNESCO.

expressed levels of knowledge, the 400 forum members (20 each in 20 villages) began with an average of 6.4 before and ended with an average of 12 points after the experiment; the 200 respondents in the 10 control villages with radio but no forum groups began with an average of 5.5 and ended with an average of 7.0. For the 200 respondents in the 10 control villages without radio nothing changed: the average was 4.0 before and 4.5 after the experiment, which represents a negligible difference due to chance fluctuations between doubtful and wrong answers."¹

Besides increasing knowledge and presumably changing attitudes toward development, the organizational aspects of the forums have been notably successful in inducing local village efforts to undertake community development projects. The importance of organization in effecting action will be discussed further in Part B of the Conclusion.

Communist China

In a different context the Chinese Communists used for some time (beginning in 1950) a sort of community listening system under their Radio Broadcasting Monitoring Network. This involved the use of "monitors," who were government personnel, whose duties were

to listen to and take down news, political instructions and other important content broadcast by the Central and Provincial People's Broadcasting Stations. The monitors should introduce and announce the programs broadcast by the stations mentioned above and organize the local people to listen to

¹P. M. Neurath, "Radio Farm Forum as a Tool of Change in Indian Villages," Economic Development and Cultural Change, Vol. X, No. 3, April 1962, p. 275.

important programs (such as lectures by government leaders and special lessons on social science).

monitors were to be appointed in "all organizations, agencies, factories and schools," as well as in the community and the army. The monitors, who were chosen for being "activists," were either full or part-time and presumably received technical training for the job. Radio monitoring was used by the Chinese mainly from 1950 to 1955. (In 1956 there were 48,700 monitoring teams.) After that, as the collectivization of villages proceeded, they began to employ wired broadcasting instead. For a discussion of this change see Part 2.¹

Korea

Community radio has been used elsewhere. In South Korea, for instance, many myon (a large village designated as a government administrative unit) governments own their own amplifier systems. In most cases the system is installed in a market place with four trumpet-type loudspeakers powered by a 50 watt tuner-amplifier. Government programs and local announcements are carried, the usual operating hours being during the morning and noon hour.

In 1961 Korea had a total of 2111 amplifiers with 12,843 loudspeakers in its primary school system. Of a total of 4768 primary schools, 2111 or 45 percent had amplifier installations. The national average was one speaker per 3.2 class-

¹The above information is from A. P. L. Liu, "Radio Broadcasting in Communist China," Center for International Studies, M.I.T., June 1964, pp. 3-11.

rooms, or 280 children per speaker.¹

Schramm describes how ingenious use was made of twenty battery-powered radios and a 50-watt transmitter in a South Korean experiment several years ago which involved rural areas. The study determined with considerable success that traditional ideas concerning health, such as causes of TB, encephalitis and typhoid, could be changed very rapidly through use of broadcast information to rural folk. The experiment also demonstrated the merit of using a low-powered transmitter in a local area with a listening radius of 25 to 50 miles and aimed at a specific audience. AID has employed this system in South Vietnam, supplying remote villages with 50-watt transmitters and a number of battery-powered transistor receivers.

Community Radio Costs

One of AID's major inputs of this type of equipment into Vietnam as a combination community radio and public address system manufactured for AID by Arvin Industries, Inc. Four thousand of these Community Radio Receivers (Arvin Model 63 CRA 11) at a cost of \$100 each were sent to Vietnam in 1963. The radio was medium range (535 to 1605 Kc) with a frequency response of 300 to 3,500 cps. It was a 10 transistor, 2 diode combination receiver-amplifier powered by D-size batteries but with a cable for attachment to a storage battery. It was supplied with tape recorder and phonograph input plugs, a micro-

¹ Figures on school installations are from "General Evaluations of Nationwide Public Information and Propaganda: Public Distribution Conditions" published by the Research Bureau, Ministry of Public Information, Government of the Republic of Korea, September 1967.

phone and both indoor and outdoor loudspeakers. It was reported to have been "very satisfactory in every respect" for use in Vietnam.¹ For use of this radio in a wired radio system see Part G.

The major differentiating aspect of a community radio is not necessarily that it have a separate loudspeaker for use in a public square, town hall or school room, but merely that it be a radio which has sufficient sensitivity for good reception and sufficient power for good output so that a larger group than a family or an individual can easily listen to it. These requirements mean that it will be more expensive than the normal transistor radio. Because of its cost, however, it may not be appropriate for some applications. For this reason some specialists do not advocate it for large scale investment. Mathur, for instance, favors waiting for the "five dollar" transistorized set, which he feels will be a great boon to India. "Now that All India Radio has increased the number of medium-wave transmitters and brought the bulk of the population within listening range, single-band transistor radio sets would seem to be a better alternative to the existing expensive community set," he contends.²

The radios supplied by UNESCO for use with the Radio Rural Forums in Togo and Ghana were manufactured by the Philips Company, all of whose equipment is tropic-proof. The radios used in Togo were transistorized (model 6BX) and cost \$30

¹A. J. Richards, Manager, Operations, Electronic Systems Division, Arvin Industries, Inc., Columbus, Indiana, personal communication, letter, August 20, 1965.

²J. C. Mathur, now Joint Secretary, Indian Department of Agriculture, personal communication, letter, March 30, 1965.

each for 160 of them (650 more have already been purchased by the Government of Togo). The radios used in Ghana were presumably the same. In the latter case, however, it was found that the sets were not really powerful enough for many of the remote villages in which the project was carried out. There was apparently considerable difficulty in hearing the programs clearly, particularly when meetings were held "under a mango tree."¹

As with all radio equipment, better quality can be had at a higher price. Sylvania, for example, offers a 10 transistor AM/FM radio (model TR64) with a 3" speaker for \$47, a 9 transistor AM/FM radio (model TR35) with a 4" speaker for \$75, and an AM/FM short wave radio (model TR40) with a 5" oval Alnico PM speaker for \$65.

Because radios of different qualities are available and because the radio requirements may vary even within a given program (as in Ghana) because of distance from a transmitter, interference, etc., it is only reasonable to conclude that the optimal use of limited resources will be in securing the equipment which is most suitable to the needs of a particular situation, rather than attempting to design or prescribe a single type of radio that must satisfy the needs of a very large range of conceivable situations. Michaelis has suggested, for instance, that "in very large projects it may prove economical to 'zone' the receivers. That is to use low-sensitivity receivers in zones close to the transmitters,

¹H. C. Abell, op. cit.

and higher-sensitivity receivers in zones where the signal is weaker."¹

It may also be important to consider using different combinations of community radio, individual transistor radio and wired radio systems to achieve different developmental goals.

C. Transistor Radios

There is a consensus among some communications experts that the crucial need of the developing countries is to provide good transistor sets in vast quantities within the price range of the average family. They seem confident that if only a plentiful supply of reliable receivers is made available to local populations at a price of between four and five dollars there will be a remarkably rapid growth of listeners in rural areas. In both the Africa and Asia UNESCO meetings on Mass Media and in the general UNESCO Report on "Mass Media in Developing Countries," there was a strong endorsement of this one--and only one!--solution. Reliance was placed almost entirely upon a study of low-cost receivers undertaken by the International Telecommunication Union at UNESCO's request with the hope that governments in less developed countries could be given one or two standard receiver designs. It was anticipated that governments would then take the initiative in setting up industries to manufacture the sets if such facilities were not already existent.

Let us examine the proposition that production of a good

¹T. B. Michaelis, "Radio and Television Receivers," Revision #1, Agency for International Development, Washington, D.C., June 1965, p. 11.

four to five dollar transistor receiver in emerging nations will result in an exponential acquisition of sets and growth of radio listenership. One is reminded of panaceas in other fields prophesized for some developing nations. Two in particular come to mind. Agricultural experts in the Republic of Korea pressed hard for the domestic production or import of small paddy tractors (rototillers) capable of plowing twice as deep as traditional methods on the grounds that deeper tilling would result in vastly expanded productivity and farm income. Pakistanis felt that if American scientists could only help them solve the problem of soil salinity and waterlogging, they could rapidly return millions of acres to productivity. In the Korean case, a year-long farm management study in several villages proved conclusively that the introduction of paddy tractors without simultaneous improvements or adjustments in other inter-acting elements (e.g., seed, fertilizer, soil analysis, crop selection, alternate use of bullocks, etc.) would prove economically disastrous.¹ Dr. Jerome B. Wiesner, a former Presidential Science Adviser, demonstrated that one could not effect a simple technological solution to Pakistan's salinity problem without taking into consideration a multitude of related factors all of which had a direct bearing upon agricultural productivity.²

¹Mr. Eilers, serving in Korea with the Asia Foundation, provided funds for a 12-month farm management study to analyze the possible effects of paddy mechanization. Impressed with the widespread introduction of paddy tractors in Japan, the Koreans became convinced that mechanization was the answer to their low rice productivity.

²Jerome B. Wiesner, Where Science and Politics Meet (New York: McGraw-Hill, 1965), pp. 135-138.

The extreme importance placed upon the manufacture of inexpensive transistor radios by those concerned with communications and national development in metamorphic nations suggests the need for a careful analysis of the assumptions being made and the implications arising from the proposal. Will lowering the price of transistors automatically result in a sharp rise in demand? Will factors other than cost affect purchase? Will cheap transistors really serve the ends desired? What performance can be expected of them? Will manufacturers maintain the quality called for in the ITU specifications? If not, what will result? Are transmitter systems in most countries compatible with the introduction of inexpensive transistors in rural areas? What alternatives to transistor sets could prove to be less expensive, more appealing and more symbiotic with indigenous cultural and economic patterns? A good place to begin is by taking a hard look at transistor receivers.

Pros and Cons About Transistor Radios

Sale of miniature radios of five or six transistors in American discount department stores for under five dollars might erroneously lead one to conclude that, like paperbacks, if they can only be produced in sufficient quantity for less advanced nations and with a small profit margin, the price can meet the UNESCO target and the problem will be solved. It is not that simple. Even a cursory examination of inexpensive transistor sets reveals poor selectivity, heavy bat-

tery drain, distortion at higher volume, low fidelity at any volume, varying sensitivity, fragility of components, and usually an undesirable signal to noise ratio and station discrimination.

Several studies have been made in recent years with the aim of drawing up specifications for transistor radios suitable for developing country needs. UNESCO's requested study by ITU produced in 1963 specifications for three types of receivers: a low sensitivity medium-wave radio, a combined medium and short-wave radio, and a medium sensitivity FM radio.¹ No cost estimates were made by the ITU. A later study by an American consulting engineer, financed by the Agency for International Development, produced a more comprehensive series of specifications together with estimated costs of each receiver design.²

Drawing a composite of the ITU and AID specifications, one pictures the attributes of the ideal receiver as being simple in design; reliable in operation; rugged enough to withstand misuse, dust, high temperature and humidity; consuming little power; battery-operated with dry cells very easy to change; and low in cost. Indicative of the exacting specifications AID has drawn up is the test for ruggedness: the set (in a plastic case!) must be able to withstand three

¹C.C.I.R. Recommendations 415 and 416, Study Program 170 (XII), Geneva, 1963.

²T. B. Michaelis, "Radio and Television Receivers," U.S. Agency for International Development, Washington, D.C., April 1964, and Revision #1, June 1965.

six-foot falls to a concrete floor without damage.¹

It is not possible to identify any countries that have adopted the ITU specifications for the domestic production of transistor receivers. Therefore, no information regarding the cost of manufacturing sets of this type is currently available. Because of the wide variations in minimum requirements between the ITU and the AID specifications, one cannot make more than a rough estimate of what an ITU-designed set would cost if produced in the United States with U.S. labor and materials. An American one-band set of less sensitivity, more fidelity, about the same selectivity and signal-noise ratio, if produced in quantities of 100,000 or more might cost \$11 to \$12. AID argues that even granted that labor costs may be much less in some countries, the extent of automation now employed in manufacturing transistorized American receivers makes it extremely unlikely that another country could produce them for less. In fact, AID believes that they would probably be of lower quality because of less experienced labor and quality control and would probably run closer to \$15.

In one research study, designed to test the comparative effectiveness of different communication media under actual conditions, 240 transistor radios were used in two relatively isolated towns in the Andean Mountains of Ecuador. The radio receivers were purchased at a cost of \$12 each from the authorized distributor for Admiral products in the Washington, D.C., area, the Legum Distributing Company of Baltimore, Maryland.

¹Information here and in subsequent references to AID programs is based upon an interview on April 2, 1965, with Walter E. Smith, Chief of AID's Radio and Television Section in the Technical Assistance Division, Washington, D.C.

They were 6-transistor, battery-operated Admiral Triumph radios which permitted reception on the regular AM band from 550 to 1550 Kc, and which were selected on the basis of bids from five manufacturers. Although the radios are reported to have received well, battery changes were required far more frequently than it had been believed would be the case. These radios were therefore not recommended for use on a large scale.

The radio transmitter used in this project was designed specifically for the project by a firm in Quito, Ecuador. It had a 500-watt output, an L-type antenna, a five panel channel, microphone and adjustable voltage transformer. It broadcast at a frequency of 1400 Kc and is reported to have performed well.¹

The prototype AID receiver is a seven transistor, single-band (medium wave) model with plastic case powered by four flashlight batteries. As AID is constantly trying to improve the quality of the receivers and yet lower the costs, the following listing shows how the prices for different sensitivity-rated radios, in quantities of 10,000 and 50,000, were lowered over the period of about one year.

¹The above information is from "Communication and Motivation in Community Development: An Experiment," November 1963, revised December 1964, a report submitted to The Office of Research and Analysis, U.S. Agency for International Development, under Contract AID/1a-27 (rapas-18), pp. iii, 24 and 116, and from (Mrs.) Johnette B. Clark, Administrative Associate, International Research Institute, American Institutes of Research, Washington, D.C., in a personal communication, letter (addressed to Dr. Birtrill A. Lloyd, Office of Research and Analysis, AID), August 17, 1965.

Table 7. Estimated Costs for Family Radio Receivers¹

<u>Sensitivity</u>	<u>Number of Sets</u>			
	<u>10,000</u>		<u>50,000</u>	
	<u>1964</u>	<u>1965</u>	<u>1964</u>	<u>1965</u>
300 uv/m, *1 band	\$12.50	9.03	\$11.00	\$ 8.60
150 uv/m, 1 band	14.50	9.45	12.00	9.00
150 uv/m, 2 band	28.00	14.39	26.00	13.70
150 uv/m, 3 band	33.00	18.49	30.00	17.30
50 uv/m, 1 band	16.00	13.44	13.00	12.80
50 uv/m, 2 band	30.00	18.28	27.00	17.40
50 uv/m, 3 band	34.00	22.05	31.50	21.00

*(uv/m = microvolts/meter)

As of September 1965, the single-band 300 uv/m radio in quantities of 50,000 costs \$7.50.

A better quality nine-transistor set powered by six flashlight batteries is manufactured by General Electric for AID at \$11.89 (G.E. model P970-M2). The sets are usually imported duty-free by AID missions, and supplied through grants approved by host governments to rural organizations such as farmers' cooperatives. The organization then sells the set to its members at approximately AID cost and finances its own development programs with the proceeds. Both sets have "foolproof" separate battery compartments making it theoretically feasible for individuals with almost no mechanical ability to change batteries, attach antennas and tune in stations.

In the Republic of Korea the least expensive 5 or 6 transistor radios currently sell for around \$10. They are produced

¹Extracted from Michaelis, April 1964, p. 12 and June 1965, p. 19.

by seven manufacturers, one of which, Gold Star, is developing a sizeable export market in South and Southeast Asia. The writer's examination of several models in the \$10-\$18 price range leads to a conclusion that they do not meet the ITU or AID standards. Korean manufacturers continue to depend upon Japanese transistor components, but all other parts are made in Korea. Sets require four batteries. Locally made dry cells cost about 10 cents each.

In other developing countries tube-type receivers remain in wide use and continue to be manufactured in large quantities. Aluminum saucepan single-band shortwave radios with four tubes and powered by an external battery with 300 hours of service sell duty-free for about \$14 in African countries. They are manufactured in the United Kingdom. In Nigeria imported four-tube radios range in price from \$14.40 to \$33.60.¹ In Communist China, five-tube radios with three-band short and medium wave coverage run from \$50.40 to \$80, although some less expensive three and four tube sets of both battery and A.C. design are manufactured in Shanghai.²

Transistor receivers, however, have many advantages over sets with tubes. They are smaller, lighter and consume much less power. Fewer repairs are necessary. Transistor sets are usually more rugged and less affected by humidity, dust and general abuse. Yet, they have many drawbacks as

¹George A. Coddington, Jr., Broadcasting Without Barriers (Paris: UNESCO, 1959), pp. 52-53.

²Alan P.L. Liu, Radio Broadcasting in Communist China (Cambridge: Center for International Studies, M.I.T., 1964), pp. 27-28.

well. Use of smaller speakers sacrifices fidelity. Station selectivity is often poor. Cheaper sets pick up only strong signals and noise levels are often higher than desirable.

Other receiver alternatives are sometimes considered. UNESCO is studying the feasibility of low-priced receivers powered by kerosene lamps for use in remote areas.¹ The trend toward miniaturization is making for even smaller components and perhaps eventually less power consumption. Micro-components such as the tunnel diode now mass produced may further stimulate low-cost production of receivers aimed at developing country markets. Tropical areas where solar interference and lack of transmitter frequencies in the broadcast spectrum is a serious problem may find that inexpensively-produced FM receivers will overcome the difficulties now blocking the expansion of broadcasting.²

D. The Growth of Wired Radio Systems

Wired broadcasting or rediffusion (a British term) refers to sending programs from a central point (studio, amplifier) via a wired distribution network to listeners subscribing to the system. These systems have been used extensively in certain regions of adverse conditions of reception or where for some reason the expense of regular wireless diffusion is beyond the reach of the listener. In some countries companies or individuals operating such systems are permitted to produce and

¹UNESCO, "Developing Mass Media in Asia," op. cit., p. 29.

²UNESCO, World Communications: Press, Radio, Television, Film (Paris: UNESCO Publications Center, 1964), pp. 27-28.

originate programs themselves. In Britain, however, this is prohibited by British Post Office regulations. In 1950 a total of 337 wired exchanges in Britain were serving almost a million subscribers. At the same time there were slightly less than 12 million radio licenses. Half of England's county boroughs have refused wired relay systems; if these were serviced, wired broadcasting could conceivably achieve 20 percent of total listenership in Britain.¹

Wired broadcasting is employed widely in Europe and Scandinavia, and particularly in the Communist Bloc.² Ceylon,

Table 8. Occurrence of Wired and Wireless Receivers

<u>Country</u>	<u>Wired Receivers</u>	<u>Wireless Receivers</u>
Austria	13,840	2,026,400
Belgium	114,270	2,529,830
Bulgaria	487,600	1,013,200
Communist China	4,500,000	6,991,200
Czechoslovakia	687,210	3,103,650
Fed. Repub. Germany	100,000	16,332,000
Hungary	260,000	2,054,000
Netherlands	477,000	2,587,000
Poland	1,281,800	4,204,800
Rumania	762,000	1,403,000
Switzerland	394,000	1,096,000

Hong Kong, Singapore, Korea and Mongolia also make extensive use of this system. Albania has an intensive state-run redistribution system with centers in Tirana, the capital, and substations in various parts of the country. Few statistics are

¹Codding, op. cit., p. 29.

²UNESCO, World Communications: Press, Radio, Television, Film, op. cit.

available on wired systems in developing countries. Aside from the Republic of Korea, Communist China and India, little information is given.

Wired broadcasting employs three major systems. The most primitive type, high level, low-frequency distribution, involves an amplifier powerful enough to actuate a loudspeaker without any amplification or power supply at the speaker. Where subscriber density is high, sometimes cables carrying several programs are employed. The listener then selects the program desired by a switch on the speaker housing.

The low-level, low frequency distribution method sends a program at about the same level as a telephone signal. An amplifier is then required at the loudspeaker. This system frequently employs existing telephone lines which means that if the subscriber receives a phone call the broadcast is cut off.

The third type, the "carrier current" system, sends out radio frequency modulations just as it would over a transmitter but they are sent to the receiver by wire. The subscriber requires a radio to receive the signal and tunes in the broadcast as he would a wireless station. The wire used is often an electric power cable. Student broadcasting stations widely employ this system on American university campuses. Unlicensed by the Federal Communications Commission, they make use of the campus electric power system in order to restrict listenership to the university community.

One should also distinguish between relatively low intensity signals distributed by wire to loudspeakers in village

huts in developing countries and the considerably higher power inputs required to operate loudspeakers in village squares or classrooms.

In all of the systems mentioned, the distribution center may make extensive use of AM and FM tuners to pick up broadcasts from central wireless stations together with tape recorders, phonographs and local studio facilities for program origination.

The principal advantage of wired systems is the lack of interference from the atmosphere or other stations. When broadcasts are relayed by wire, extremely sensitive radio frequency tuners and efficient antenna systems can be employed to pick up distant broadcasts which would be inaudible on inexpensive transistor receivers. A second advantage is comparative expense. In many instances the receiving apparatus and installation of wire and speakers is less costly to install and maintain than a high-powered transmitter. The subscriber pays a modest monthly fee and his speaker is installed and maintained by the firm running the system. Perhaps the greatest disadvantage in wired broadcasting is that the subscriber can only listen to what the system decides to distribute unlike the transistor owner who, theoretically at least, has a wider choice. It will be well to consider this point more carefully when transistor receivers are compared with wired rediffusion.

Wired Broadcasting in Communist China.

Liu has reported that "the Chinese Communists have two

major reasons for their plans to develop wired instead of wireless broadcasting.

"First, wired broadcasting, the Chinese Communists frankly admit, is cheaper than wireless broadcasting. According to a Communist estimate, the building of one wired broadcasting station with 150 loudspeakers would cost ¥7,000 (\$2,800) and the monthly maintenance cost would be ¥90 (\$36). But to buy 150 radio sets would cost ¥20,000 (\$8,000) and the monthly maintenance cost would be from ¥1,500 to ¥2,000 (\$600 to \$800). Furthermore, every radio set requires one operator."¹

The second reason was that "with loudspeakers in public places or even in peasants' homes, the Communists not only control people's listening but also insulate them from enemy broadcast." Whether cost or control is more important to the Communists cannot be said.

The major problem the Communists have faced has been a lack of electricity, but even then it is reported that the number of wired stations grew from 8 in 1949 to 11,124 in 1959 and the number of loudspeakers grew from 500 in 1949 to an estimated 4,500,000 in 1963. This is shown in the following table.

A diagram of the methods of control and distribution used on the Chinese mainland is shown in the figure which follows the table.

The Chinese Communists have also made efforts to establish wired radio broadcasting in the areas inhabited by their

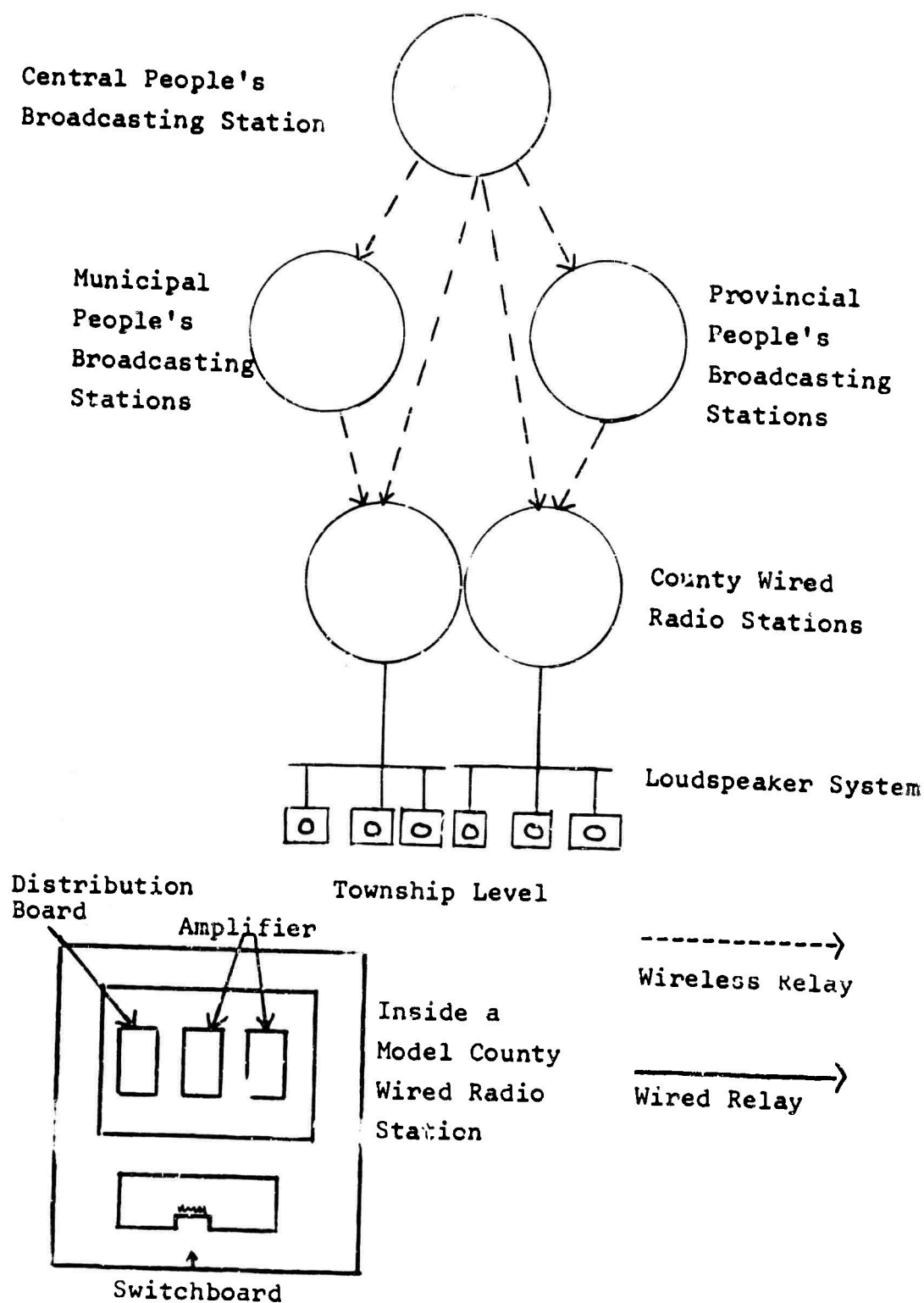
¹ Wuhsientien (Radio), No. 2, 1956, p. 5. (¥ stands for Communist Chinese dollar.)

Table 9. Growth of Wired Broadcasting Stations in Communist China¹

<u>Year</u>	<u>Number of Wired</u>	
	<u>Broadcasting Stations</u>	<u>Loudspeakers</u>
1949	8	500
1950	51	2,200
1951	183	6,100
1952	327	15,200
1953	541	31,800
1954	577	47,500
1955	835	90,500
1956	1,490	515,700
1957	1,700	993,200
1958	6,772	2,987,500
1959	11,124	4,570,000
1960	—	—
1961	—	—
1962	—	—
1963	—	4,500,000

¹Figures from 1949 to 1958 are from Ten Great Years, Foreign Language Press, Peking, 1960, p. 208; figures of 1959 are from Communist China Digest, Joint Publications Research Service, U.S. Department of Commerce, No. 20, July 26, 1960, p. 56. Among the 11,124 stations, 1,689 were county stations, and 9,435 commune stations. The figure of 1963 is based on New China News Agency (Peking) release on August 7, 1963, which reported that, in fact, the number of loudspeakers was "more than 4.5 million" in 1963. (Quoted from Alan P. L. Liu, "Radio Broadcasting in Communist China", Center for International Studies, M.I.T., June 1964).

Illustration 1. A Schematic Representation of Wired Broadcasting in Communist China



approximately 50 minority nationalities, which number about 38,000,000 people. By 1959, for instance, 58 percent of the communes in Inner Mongolia had wired broadcasting stations.

Liu has concluded that for the Chinese Communists "the wired broadcasting network is apparently intended to be the permanent network because the official radio journals speak constantly about the economy and function of the wired network both in peace and in war."¹

A Study of the Korean Experience with Wired Broadcasting and Transistor Receivers²

This is neither a comprehensive nor rigorous analysis of the use and implications of transistor receivers and wired broadcasting systems in the Republic of Korea. Rather, with limited field data, our intention is to see if through an analysis of the Korean situation we can obtain a better grasp of some of the capabilities and limitations of each system for the needs in developing nations.

¹The above information is from A. P. L. Liu, "Radio Broadcasting in Communist China," Center for International Studies, M.I.T., June 1964.

²Some information has been drawn from Mr. Eiler's preliminary study of wired broadcasting in the Republic of Korea during 1963. Additional data has been provided by Mr. Pak Tai-jin, a Korean radio engineer, to whom Mr. Eilers sent a detailed list of questions concerning radio reception in Korea. Mr. Pak's material was prepared during April 1965 and is based upon interviews with several owners and managers of wired rediffusion systems, manufacturers and officials of the Korean Broadcasting System. The authors are very grateful to Mr. Pak for the excellent data supplied.

History of the Rediffusion Movement

Wired broadcasting was introduced in South Korea around 1958 during the latter years of the Rhee regime. The initial installation involved 430 amplifiers donated to model community development villages. Each amplifier had 100 speakers. The systems were imported from Philips in the Netherlands, having been especially developed according to specifications drawn up by the Korean government (see pp. 108-112). In commemoration of the first anniversary of the military revolution, in May 1962, President Park Chung-hee provided an additional 700 systems to rural villages which had excelled in the National Reconstruction Movement. Each amplifier included about 220 speakers. Since then the Government has conducted a nationwide campaign soliciting funds for the purchase of speakers for villages, with a target of 100,000 (unattained). The Ministry of Public Information purchased the speakers at cost (\$1) and donated them together with field wire worth \$11,700 to registered entrepreneurs in provincial areas through the "Wired Rediffusion Cultural Association." According to statistics supplied by this Association and from the Ministry of Public Information of the Korean Government, as of April 1955 there were 76,577 speakers operating from government amplifiers and 704,783 speakers linked to private systems, or a total of 781,360 speakers in South Korea. (UNESCO sources list only 111,300 wired receivers as of 1960 or 1961.) More than 2,500 entrepreneurs are operating rediffusion systems in

in Korea, and there are now a total of about 3,549 amplifiers, as shown in the following table.

Table 10. Wired Rediffusion Systems in Korea

January 1965

<u>Province</u>	<u>Number of Amplifiers</u>			<u>Number of Speakers</u>		
	<u>Govt.</u>	<u>Private</u>	<u>Total</u>	<u>Govt.</u>	<u>Private</u>	<u>Total</u>
Seoul (Special City)	5	95	100	470	28,500	28,970
Pusan (City)	2	21	23	120	6,800	6,920
Kyunggi	130	291	421	8,647	85,577	94,224
Chungpuk	106	222	328	6,750	63,526	70,276
Chungnam	127	350	477	9,920	102,352	112,272
Chunpuk	117	197	314	8,100	66,685	74,785
Chunnam	186	443	629	12,720	125,123	137,843
Kyungpuk	171	330	501	11,970	97,960	109,930
Kyungnam	140	368	508	10,050	94,525	104,575
Kangwon	104	105	209	6,410	29,500	35,910
Cheju	<u>24</u>	<u>16</u>	<u>40</u>	<u>1,420</u>	<u>4,235</u>	<u>5,655</u>
Total	1,112	2,437	3,549	76,577	704,783	781,360

E. Operation and Cost of Wired Radio in Korean Villages

Since Government dominates the wireless broadcasting field in South Korea, it seems unusual that two-thirds of the wired broadcasting systems are run by private entrepreneurs with strong encouragement from the Government. The average cost for a full village rediffusion installation, which includes a 50 to 500-watt amplifier, usually around 250 speakers and 15 to

20 miles of Army-type field wire, is about \$900. The entrepreneur must raise two-thirds of this, the balance being derived from "key money" or deposits for the speakers paid by subscribers. Formerly, credit was supplied to village entrepreneurs by manufacturers, but as a result of the rapid inflationary spiral this practice was discontinued.

The monthly subscription charge is 19 cents in urban areas and 15 cents in villages or small rural towns. In villages fees are collected once or twice a year. Payment is often made in kind, e.g., grain. Default on fees has not been a problem in provincial systems. In city or suburban areas, collections are sometimes slower. If the fee is not paid, a subscriber is usually carried on credit for six months. Then the speaker is removed and the deposit is retained to cover the delinquent fee.

In nearly all installations a tuner is an integral part of the amplifier. Most tuners have shortwave and medium wave capabilities. Some systems have turned to FM tuners when AM reception is consistently bad in their village. Tuners are locally manufactured with surplus U.S. military components; AM tuners cost \$19; FM tuners, \$46. Since the Korean Broadcasting System employs 25 FM transmitters to relay Seoul broadcasts it is often possible to intercept these transmissions. "T" or "L" types of antenna systems are employed. An FM antenna, locally made, costs \$8; its installation may run anywhere from \$8 to \$115, depending upon the terrain and local conditions.

Amplifier power in villages runs from 50 to 500 watts, one watt supplying two to five magnetic-type speakers. Each speaker requires from 0.2 to 0.4 watts, depending upon volume and the impedance match. Speakers of two types are employed: eight-inch magnetic speakers costing \$1 and four-inch permanent magnetic speakers costing \$2. All speakers are locally manufactured, the price includes plywood baffle, volume control and on-off switch. In many cases a family subscriber will use more than one speaker since a reduced fee is charged for a second speaker in the same hut, just as Bell Telephone makes a much smaller charge for an extension phone.

The usual power source for village amplifiers is a 12-volt battery, except for a few villages with rural electrification. Batteries are charged by a gasoline-operated DC generator owned by the entrepreneur, usually U.S. Army surplus in origin.

A fully transistorized amplifier can produce up to 50 watts power output. Power needs beyond this usually require an AC source. Costs of amplifiers, all domestically manufactured except for transistors or diodes imported from Japan, are: 50 watt, \$57; 100 watt, \$76; 250 watt, \$152; and 500 watt, \$267. Most installations have a battery-powered tape recorder, turntable and pickup, and one or two microphones. Nearly all have a supply of tapes and records, the usual facility containing about 50 to 100 tapes, chiefly music, and a few records.

Amplifiers powered from an AC source are frequently used for feeding up to ten or fifteen villages, the average distance

between villages being 6/10 to 7/10 of a mile. Compensation for line loss is accomplished by adjusting the output impedances of the power amplifier so that fairly good response is maintained. The most popular field wire is U.S. Army W-190. Iron-wire, non-insulated, 1.6 mm to 2.10 mm diameter, is also used. Both types are now produced in Korea. Cost of W-190 per 100 feet is 30 cents; for iron wire, non-insulated, 11 cents per 100 feet; insulated, 32 cents per 100 feet. In multi-village installations the average length of installation from amplifier to subscriber is about 5 miles. For the average installation, it is estimated that each hut speaker requires about 160 yards of wire. For a 100-speaker installation, about 10 miles of wire is needed; for a 500-speaker facility, about 28 miles.

Speakers are usually located in the ondol (heated radiantly) floor room, turned facing the courtyard so programs may be heard outside in warm weather. In some cases speakers are placed in the room occupied by grandparents.

Field wire is usually strung on locally-hewn wooden poles. In many cases it is hung on trees along the road or in fields. Major difficulties experienced with field wire in Korea arise from (1) wind, which blows down wire or leads to shorts; (2) children, who cut or ground the wire; (3) theft; and (4) lightning. It is interesting that the difficulty with children occurs only when the wire is first installed. When they realize that tampering with wire will deprive them of children's radio programs they soon learn not to touch it. Entrepreneurs make sure that children's programs are regularly carried.

Content and Effects of Broadcasts Carried by Rediffusion Systems

The average tuner is able to receive three to six medium-wave stations with a quality suitable for rediffusion. Most tuners have short-wave capabilities. Government regulations prohibit entrepreneurs from carrying programs other than those originating from the Korean Broadcasting System and its affiliated stations, local announcements and local entertainment. They are precluded from carrying Korea's commercial stations, the U.S. armed forces broadcasts, or Japanese programs. Local police occasionally monitor rediffusion systems to assure compliance.

Operating hours of most facilities are from 5:00 a.m. to 11:30 p.m. When government radio stations are off the air, or carry programs of little interest to their listeners, entrepreneurs play tapes and records. There is little initiative or reward for other programming and no attempt is made to carry local advertisements. Frequently, the rediffusion system carries agricultural programs beamed over the government's second program, its educational and cultural network. Villagers show little initiative in expressing their program preferences to the operator of the local system. According to a small interview sampling of entrepreneurs, programs in order of popularity are: news, weather forecasts, drama, folk music, popular music and news comment.

F. Comparison of Transistor Radios and Wired Radio Systems in Korea

To draw broad inferences from the Korean experience

concerning rural radio communications in societies with differing cultures, patterns of urban-rural settlement, interests and attitudes, systems of national transmitters, atmospheric conditions and geographical factors would be foolhardy. We may be justified, however, in coming to some tentative conclusions.

First, we can seriously question the assumption that a technological advancement making it possible to manufacture a transistor receiver at around \$5 will result in a vast increase in the use of receivers in rural areas. Even if farmers are prepared to invest their savings in such an investment, which is a doubtful proposition, it remains highly questionable whether a \$5 transistor set will have satisfactory sensitivity for use outside urban or suburban areas.

There also seems to be little guarantee that manufacturers, naturally desiring to produce low cost receivers for local markets, will be guided by the ITU specifications. With standards lowered, it is likely that rural listeners will find locally-made radio sets unsatisfactory for countryside use.

In addition, in societies such as Korea, where theft is endemic, a transistor set is a prime target for thieves. In Korea theft of speakers has been far less of a problem than that of transistor sets. Wire theft remains somewhat of a problem, but does not mean a loss to the individual listener.

Transistor Receivers in Korean Villages

Entrepreneurs and Ministry of Public Information officials interviewed expressed the view that even if transistor radios

were sold at between four and five dollars, few would be purchased by the inhabitants of Korea's 20,000 villages. Most villagers would be reluctant to invest that much money in a radio and few have savings sufficient to buy one. A transistor receiver at this price would obviously have to be medium-wave only with single-stage RF amplification, thus rendering it incapable of good reception in most villages. Dry cells are still too expensive (10 cents for 1.5 volts) for the villager. If the village resident operates his transistor receiver from power mains, then it will be less expensive. However, in the great majority of cases rural residents must rely upon battery-powered sets. If the owner of a battery-powered transistor set listens at normal volume a minimum time, say two hours a day, his batteries will probably not function effectively for more than two or three months. In Korea, where batteries are locally manufactured, battery replacement will then run 40 cents, or roughly 20 cents per month.¹ Receivers operated at a high volume level for longer periods each day will require more frequent battery replacement. Whereas the owner of the battery-powered transistor set may tend to limit his listening in order to conserve his batteries, the radio subscriber may be inclined to have his speaker active many of the 18 1/2 hours per day provided by the service in order to get his money's worth. Among the simple, frugal peasant population

¹ Sets powered by flashlight batteries require a minimum of 4 cells, each costing 10 cents. Smaller sets using "penlight" cells require a minimum of two cells, each costing 20 cents. Therefore, average battery replacement is estimated at 40 cents. Many sets, however, use more batteries. The G.E. set manufactured for AID at \$11.89 requires 6 cells, costing 60 cents. Many Japanese transistor sets require 4 instead of 2 penlight cells, or a total of 80 cents for battery replacement.

of the world's less advanced nations we are apt sometimes to forget that to them a few pennies a month makes a vital difference.

It is also doubtful whether farmers will spend 20 cents (more likely 40 to 60 cents) a month on radio batteries, noting particularly that at "half-life" or less batteries may reduce the set's capability to receiving only the strongest signals. Repairs may be difficult for the rural resident. He may experience difficulty in installing batteries. Most of those who own transistor radios now depend upon local repair shops to change batteries for them. Thus, it is believed that most villagers generally prefer the wired broadcasting system because it does not require a "large" investment. They do not have to be concerned about repairs or to worry about having the set stolen. Entrepreneurs have found that when their subscribers buy their own transistor radios they discontinue the rediffusion service. For this reason entrepreneurs have not sought to become retailers of transistor receivers. In some cases former subscribers have rejoined after discovering that reception on their transistor radios is not as clear and reliable as wired broadcasting.

The Ministry of Public Information also contends that a great majority of village subscribers feel they cannot afford both a speaker and a newspaper even though they purchased papers on a regular basis before wired broadcasting was introduced to the village. Newspaper subscription fees have increased during the past few years, yet rediffusion subscription fees have re-

mained constant. (A newspaper subscription costs about 80 to 100 hwan, 61 to 77 cents, per month.) Ministry informants say that the number of newspapers going into villages noticeably declines when rediffusion is introduced. Villager subscriptions to periodicals have not been greatly affected because few villagers can afford them. Although most subscribers are literate, according to the Information Ministry, rediffusion entrepreneurs state that many of their subscribers no longer bother to read newspapers once they have a speaker in their hut.

What the Korean study suggests in unambiguous terms is that of the three listening means open to the villager, wired broadcasting in areas without public power is the least expensive. The following chart suggests that in Korea the monthly wired speaker fee in provincial areas is one-fourth to one-fifth that of a monthly newspaper subscription.

Table 11. Comparative Costs of Village Media: Korea¹

	Wired <u>Broadcasts</u>	<u>Transistor Sets</u>	Newspaper <u>Subscription</u>
Present Investment	\$1.00	\$10.00	
Lowest Possible Future Investment	\$1.00	\$4.00-\$5.00	
Present Cost per Month	\$0.15	\$0.20-\$0.40 (plus repairs)	\$0.61-\$0.77

¹ Estimates based upon Hwan costs and conversion at the rate of 130 Hwan to \$1.00.

The Korean study has revealed the remarkable role of village entrepreneurs in extending radio to the rural populace as well as that of enterprising small manufacturers in producing tuners, amplifiers and loudspeakers especially adapted for village use. It is difficult to understand why the entrepreneur finds the investment economically attractive, for an average 250-speaker installation provides only a gross of \$37.50 per month, or \$450 a year, before expenses against a \$600 investment. Rediffusion system operators apparently have found it to be a satisfactory business. Those with the larger installations, e.g., 700-900 loudspeakers powered from a 500-watt amplifier in a village complex where distances are not great, probably find the operation more remunerative. Overhead is very little. A schoolboy is often hired to operate the station, make announcements and handle semi-annual collections. The major overhead expenses are probably electric power or diesel for the motor generator, purchase of tapes or records and occasional replacement of parts and wire.

The criticism is often made that wired broadcasting subscribers have very limited choice in the selection of programs, while owners of radio sets are free to roam the wave lengths and listen to what they wish. This argument may be valid for the urbanite, but the question of program choice involves other factors for rural listeners. The Korea study stated that the average rural rediffusion system can pick up from three to six medium wave stations suitable for redistribution to its subscribers. One seriously questions whether an inexpensive transistor set with single-stage RF amplification could pick up

more than one or two stations with satisfactory signal strength. On the other hand, wired broadcasting subscribers often have the advantage of listening to broadcasts from shortwave or FM relay or local taped programs during hours when government stations do not beam programs to their region.

It would be interesting to study the value rural people in a traditional or transitional society place upon freedom of choice in matters such as radio programs. The Korean sample suggests that rediffusion subscribers, while having preference as to programs, have generally been indifferent to an articulation of program choices. With radio programming in many countries still produced primarily for urban listeners, many "country" people who invest in receivers may find that programs are not prepared in the language or dialect preferred, do not cover subject matter of interest, are not carried at times suited to their work, and receive strong interference from transmissions in nearby countries.

Nations with mountainous terrain usually find it difficult to achieve comprehensive coverage with medium-wave signals. George Searle, who reported on his 1959 survey of communications in South East Asia at the UNESCO Mass Media meeting in Bangkok, believes most rural rediffusion systems "are encouraged by the interference problem." He has noted that "in Switzerland radio propagation is so difficult because of the mountains that it is better in many cases to run the radio programmes on wire."¹

¹George Searle, Second Deputy Director General, New Zealand Post Office, personal communication, letter, March 25, 1965.

Searle observed that the South Koreans suffer considerable radio interference from North China, North Korea and Japan, "which makes a central radio receiver with directional antenna in a rediffusion system preferable to individual transistor sets in non-urban areas."

G. Present Cost of Wired Radio System Components

There are numerous companies in the United States and abroad which manufacture and/or sell radio equipment.¹ All equipment of the type used in Korea, however, must be made to order. The original 430 units of 100 speakers each which inaugurated the use of wired radio systems in Korea in 1958 were perhaps somewhat more elaborate than many of the systems now being manufactured there.

For the original units of the radio, the amplifier and a 4" monitor loudspeaker were built into a single piece of tropic-proof equipment, as shown in the accompanying picture. The monitor loudspeaker in the tuner-amplifier was designed so that it could not be turned off while the radio was in operation. A table model microphone in a polystyrene housing and with an impedance of 25,000 ohms was supplied for making local inputs.

The radio part of the radio-amplifier had four tubes. Its wave range was 185-580 m (517-1620 Kc) with an intermediate frequency of 452 Kc. Specifications for the amplifier were as

¹See T.B. Michaelis, "Radio and Television Receivers," Revision #1, June 1965, special report for the U.S. Agency for International Development, Washington, D.C., for a listing of approximately 130 U.S. and 25 foreign (mostly Japanese) sources for radio receivers, pp. 119-127.



Illustration 2. Picture of Wired Radio System Components

follows:

output power	50 watts
harmonic distortion	<1% at 100 c/s
hum and noise	microphone channel > -55 db radio channel > -60 db
sensitivity	microphone input 4 mV + 20% radio input 220 mV <u>±</u> 20%
frequency response	50 c/s - 2 db 100 c/s - 1/2 db 50-20,000 10,000 c/s - 1 db <u>±</u> 2 db 20,000 c/s - 1 db
internal resistance of the output	<20% Ru (5 coils of 12 1/2 V each)
power	auto transformer with soldering taps 70, 80, 90, 100, 110 V fuse--mains switch--3 m cable with plug
controls and connections	combined volume control radio/ microphone antenna connection microphone connection ground loudspeaker connections
tubes	7 tubes and 5 silicon diodes and 1 germanium diode
dimensions	approximately 18" x 10 1/2" x 9 1/4"

The Philips Company reports that although these amplifiers had an output of only 50 watts, models with 100 or even 200 watts could also be made. In addition, while the units supplied in 1958 were basically tube-type, similar equipment would now be entirely transistorized.

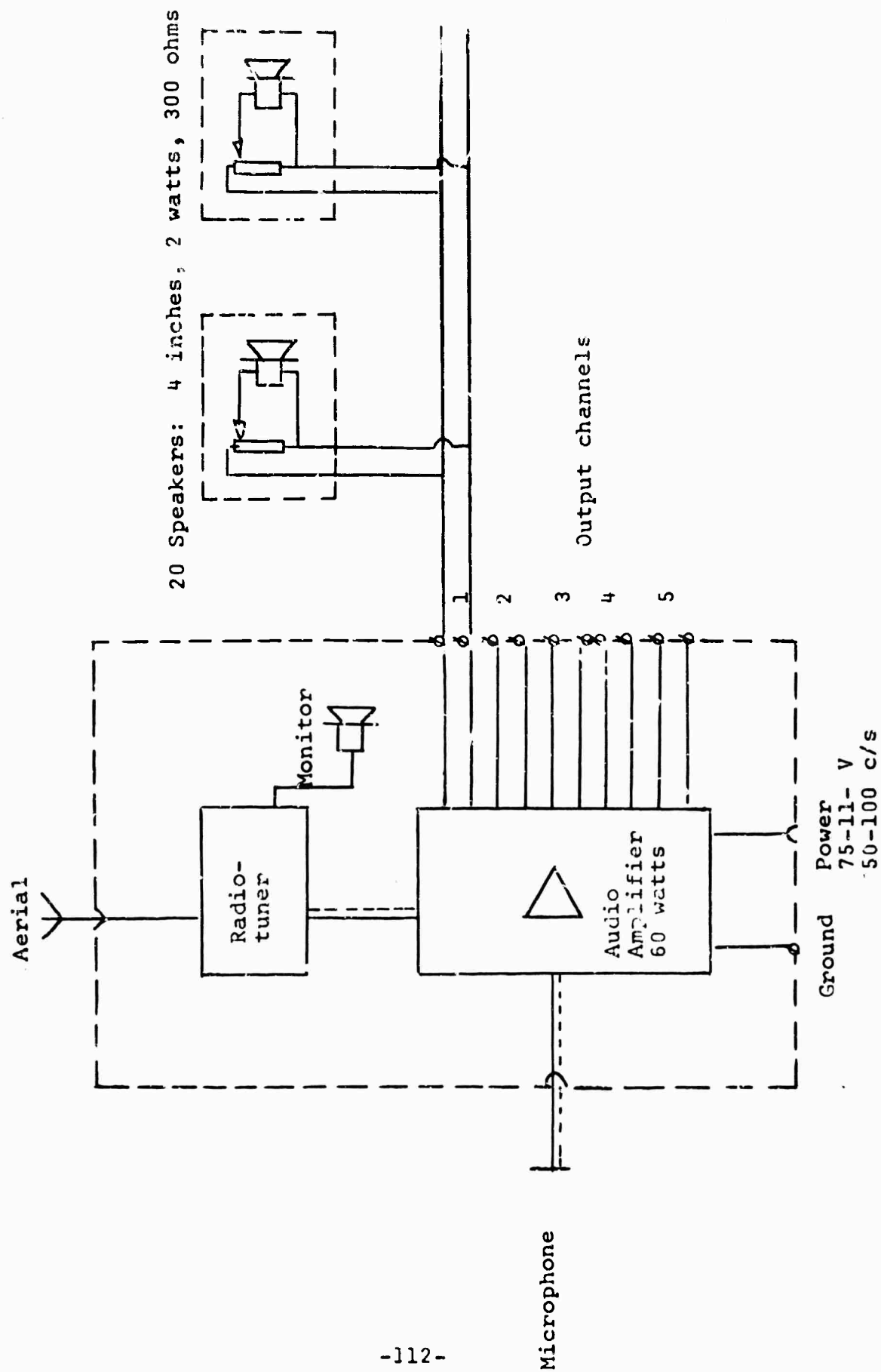
The systems used in Korea had 100 loudspeakers connected in parallel in five groups of twenty (see Illustration 3), each group having a separate secondary winding on the output transformer. Normally, the Philips equipment has an output line of 50 to 100 volts, to which all of the speakers are connected in parallel, with separate output switches provided so that different loudspeaker groups can be switched on and off without influencing the level of the remaining loudspeakers. In either case each speaker is provided with its own individual volume control. The speakers supplied to the Korean government were 4" loudspeakers with a maximum power of 2 watts and an impedance of 300 ohms. The housings for the speakers were made of polyvinyl chloride (see accompanying picture for a view of a wooden model of the speaker).

Because such equipment is custom-built, and the costs are therefore highly dependant on (a) the quantities involved and (b) the specifications required, the Philips Company was unable to quote any current equipment prices.¹

The U.S. Agency for International Development has developed a more simplified prototype of a wired system by simply adding wire and more speakers to the radio-amplifier which they had designed for use as a "community"-type radio. This system includes

¹The above information was supplied by Mr. L.J. Sterneberg, Direct Export Bureau, p.p.N.V. PHILIPS' GLOEILAMPENFABRIEKEN, Eindhoven, Netherlands, in a personal communication, letter, September 23, 1965.

Illustration 3. Diagram of a Wired Radio System



1.	One Community Radio Receiver, Arvin Industries or equivalent with microphone, battery pack, antenna and associated cables	\$60.00
2.	20 6" speakers, each with housing, control knob, matching transformer, T-pad and accessories;	90.00
3.	1 mile of WD-1-TT U.S. Army Infantry field wire or equivalent	60.00
Total		<hr/> \$210.00

These prices do not include packing, shipping or spare parts costs, so that it is thought that about \$300 ought to be budgeted for each unit. AID has not, however, had any demand for installation of these units.¹

The wired systems most widely used in the United States which face technical problems similar to those of village wired radio are the public address and "piped in" music systems used in schools, factories and other establishments. In most instances, as suggested by the Philips Company information above, a 70 volt (actually 70.7 volt and sometimes a 25 volt) line is used to which all the speakers are attached. The 70 volt line offers a number of advantages. Its use means that the length of wire used is not a critical factor in the design of the system because in most cases line losses are negligible. When this is the case, all that is necessary for the system to be operable is that the sum of the power outputs for all the speakers, arranged in parallel, be equal to the total power output (in watts) of the amplifier. The speakers need not all be

¹Mr. W.E. Smith, U.S. Agency for International Development, personal communication, interview, Washington, D.C., September 2, 1965.

the same size, but each must have its own small transformer so that it will be compatible with the system. A 30-watt amplifier, for instance, could have 15 speakers, each with a 2-watt output connected to it, or 1 speaker with 8 watts, 3 with 4 watts, and 5 with 2-watt output, and so on. Each speaker is also then provided with an "L-pad" so that when it is turned off it will reflect back to the system the same impedance for which it has been rated.

If a wired system does not employ a 70-volt line, then the speakers most distant from the amplifier receive less power because of the loss due to the resistance of the line. Also, if an "L-pad" is not supplied for each speaker and a speaker is turned off or becomes defective, it affects the performance of all the other speakers. A 70-volt, 8-ohm, L-pad costs about \$0.98. It adds to the cost of the speaker, but has compensatory effects in greatly improving the quality of system performance.

As has been noted before, it is extremely difficult to give generalized prices for equipment which really must be designed for specific situations. Nevertheless, some costs will be given here for high quality components which could be put together to make up a wired radio system. The system would include a tuner for radio reception, a pre-amplifier for microphone, tape recorder or phonograph input, an amplifier with a power output of from 8 to 175 watts or more, wire, speakers, and other accessories such as transformers. The following equipment list gives the manufacturer's standard single unit list price as of September 15, 1965, to the nearest five dollars.

Table 12. High Fidelity Equipment Cost List

<u>Description</u>	<u>List Price</u>
1. Altec AM-FM Tuner, Model No. 316A	\$250.00
2. McMartin Mixer preamplifier, Model No. LX-40	195.00
3. Tape head preamplifier, Model No. PH-9	25.00
4. Monograph preamplifier, Model No. PH-6A	25.00
5. Universal line/microphone low impedance transformer, Model No. MT-4	20.00
6. Utah speaker/baffle 8 ohm with volume control, Model No. 57DX842C	11.00
7. Altec 70 volt transformer, 1/2, 1, 2 watt primaries, Model No. 15132	6.00
8. McMartin 8 watt amplifier, Model No. LT-80B	155.00
9. McMartin 10 watt amplifier, Model No. MA-10	90.00
10. McMartin 20 watt amplifier, Model No. MA-20	125.00
11. McMartin 32 watt amplifier, Model No. LT-332	170.00
12. Altec 40 watt amplifier, Model No. 1568A	180.00
13. Altec 50 watt amplifier, Model No. 351B	270.00
14. McMartin 75 watt amplifier, Model No. LT-750	460.00
15. Altec 80 watt amplifier, Model No. 1569A	225.00
16. Altec 175 watt amplifier, Model No. 1570B	375.00
17. Belden (CBS) audio wire, Model No. 8437	35.00/1000'
18. Altec 70 volt transformer, 1, .5, .25 watt primaries, Model 15064	9.50

To give an idea of possible variations in cost, however, it should be noted that a fully transistorized 32-watt amplifier with a list price of \$170, as above, has a dealer's price of about \$105 and a distributor's price of approximately \$65.¹

The equipment described above is normally used for the high fidelity reproduction of music. Although the prices are high, especially when compared to those for the Korean equipment, they ought, nevertheless, to serve as an indication of the upper limit for applicable regularly supplied high quality commercial equipment. It is an upper limit which, unfortunately, would probably make such systems prohibitively costly for villages in underdeveloped countries. The low end of the scale may well be the prices quoted for the Korean equipment.

The only normal intermediate point on the scale is in equipment which is designed for use in public address systems and is therefore mainly for voice or background music reproduction. The quality of the sound that comes through is not as high as for high fidelity equipment. The prices are, correspondingly, lower. A tube-type 35-watt amplifier (model BE-35 of the Bell Public Address Division of Thompson Ramo Wooldridge Inc., Columbus, Ohio), for instance, has a list price of \$120, a dealer's price of \$72 and a distributor's price of \$48.

¹The above information was supplied by Mr. Gerald Goldman, Manager, Applications Engineering, Commercial Electronics Division, Sylvania Electric Products, Inc., Bedford, Mass., in a personal communication, letter, September 14, 1965.

When a very large power output is required for public address systems, booster amplifiers are supplied in separate modules which can be linked together. This requires the use, however, of a mixer-preamplifier (such as model MXMA of Bogen Communications, Inc., Paramus, New Jersey, which has a dealer's price of \$165) for microphone, tape recorder and phonograph inputs.

The following list gives the dealer's price for the Realistic line of equipment or the catalogue price (which is equivalent to the dealer's price) for other public address amplifier equipment to the nearest dollar.

Table 13. Public Address Equipment Cost List

	<u>Description of Amplifier</u>	<u>Dealer's Price</u>
1.	Realistic 5 watt	\$17.00
2.	Bell 10 watt	45.00
3.	Bell 20 watt	59.00
4.	Realistic 25 watt	60.00
5.	Bogen 30 watt booster	87.00
6.	Bell 35 watt	72.00
7.	Realistic 45 watt	75.00
8.	Bogen 60 watt booster	106.00
9.	Bell 75 watt	107.00
10.	Realistic 90 watt	96.00
11.	Bogen 100 watt booster	136.00
12.	Bogen 200 watt booster	248.00 ¹

¹The above information was supplied in part by Mr. Richard Parker, Chief Engineer, and Mr. Bernard Thompson, WCRB AM&FM Radio Stations in personal communications, interview, Waltham, Mass., August 3, 1965, and telephone, October 26, 1965.

When ordered in quantity the per unit cost of this equipment is naturally lowered. For the Realistic line of equipment of the Radio Shack Corporation, which has the lowest dollar to watt ratio for a given wattage of the above equipment, and is made mainly of Japanese components, the variation of cost with quantity would be as follows.

Table 14. Quantity Costs for Amplifiers

<u>Amplifier</u>	<u>1</u>	<u>10</u>	<u>50</u>	<u>100</u>	<u>500</u>
25 watt	\$60.00	\$57.00	\$54.00	\$51.00	\$49.00
45 watt	75.00	71.00	68.00	65.00	61.00
90 watt	96.00	91.00	86.00	83.00	78.00

In quantities of 1000 or more, the above equipment would be re-costed for the purchaser by individually re-pricing each component in the amplifier.¹

Perhaps the cheapest FM tuner available which would be sensitive enough to receive outside of the immediate vicinity of a transmitter would be the newly available Realist FM tuner for \$40. It has a sensitivity of 2 1/2-3 microvolts. In quantities of 500 it would cost about \$30.

AM tuners are hardly available at all in the United States because AM frequency limitations are such that the quality of the sound reproduction does not warrant the expense of a separate

Information supplied by Mr. O'Connor, Merchandise Manager for High Fidelity Equipment, Radio Shack Corporation, Boston, Mass., personal communication, telephone, October 26, 1965.

amplifier. There may, however, be a resurgence of combination AM-FM tuners because of recent FCC regulations requiring AM and FM stations to have a minimum of 50% difference in programming. For this reason there has already been an increase in the availability of this type of equipment on the market. There still does not, however, appear to be a future for purely AM tuners. It may be possible, though, to adapt a low cost transistor radio for use in conjunction with a separate amplifier for distribution over a wired speaker system.

In moving from tuner and amplifier to wire and speakers it is found that, even for the latter, it is difficult to match the Korean prices. Perhaps the cheapest available jacketed twisted pair of wires costs \$13/1000 feet.¹

For unjacketed copper or steel wire the labor content is insignificant because it is primarily an automated production item. Its basic cost is therefore directly proportional to the cost of the metal and is not likely to be less expensive in South Korea or Japan than elsewhere in the world.²

The Army field wire (WD-1-TT) to be used in the AID-ARVIN wired radio costs about \$11.50/1000 feet. The Army W-19J wire being used in Korea, however, was quoted in Part E, above, as being only \$3.00/1000 feet.

¹Mr. Hank Hine, sales representative, Belden Manufacturing Company, personal communication, telephone, Boston, Mass., July 8, 1965.

²A. J. Richards, Manager-Operations, Electronic Systems Division, ARVIN INDUSTRIES, INC., personal communication, letter, August 20, 1965.

For speakers the minimum cost would be, in quantities of about 1000, \$0.98 for a 4", 3-ohm, square speaker with a 1.47 ounce magnet. This is the type of speaker used in a cheap portable TV or a table model radio. A 6" speaker, which would give quite a bit better sound, would cost \$1.20.¹ Baffles for these speakers might be made out of plywood, which costs about \$3 for a 4' x 8' sheet, which could be cut up to make speaker housings, although this would not be as durable as the plastic housings supplied by the Philips Company for use in Korea.

It is clear that the lack of demand for wired radio systems has been a factor in the high cost which is currently required to put together such systems from commercially available components. The Korean experience shows, however, that the costs can be brought down and that wired radio deserves serious consideration as a means of bringing radio reception to large numbers of villagers in developing countries. Only as this is realized and as demand increases will the prices be lowered.

¹Mr. Abbott, sales representative, Oxford Electric Company, personal communication, telephone, Boston, Mass., July 15, 1965.

Chapter IV. Telephone Usage and Equipment Costs

A. Telephone Usage in Perspective

In September 1965 President Johnson signed a bill authorizing the expenditure of \$90,000,000 over a period of three years to experiment with the use of high speed ground transport (HSGT) systems to alleviate the problems of travel along the Northeast Corridor, the region from Boston south to Washington on the East coast of the United States. This three years' expenditure was viewed as being just the start of an extremely large outlay which would be necessary before the end of this century. It is significant not only because of the amount of money involved, but also because it is being spent to solve an urban transportation problem. It is indicative of the difference in transport and communications problems being faced by the developed and the developing countries. In 1960, 65% of the population of the United States lived in urban areas.¹ And the area of the Northeast Corridor has been given a new name--Megalopolis--connoting that urban sprawl has made it essentially one large extended "city."² Urban areas such as these pose new and burdensome transport and communications problems--and demand courageous new approaches to their solution. HSGT is one such approach.

The underdeveloped world is not free from urban problems, and urban problems in developing countries will grow in the future. Meier, for instance, predicts that by the end of this

¹R. L. Meier, A Communications Theory of Urban Growth, M.I.T. Press, Cambridge, 1962, p. 16.

²J. Gottman, Megalopolis, the Urbanized Northeastern Seaboard of the United States, Twentieth Century Fund, New York, 1961.

century there will be cities of 50-100 million inhabitants in some underdeveloped countries.¹

Even with such giant cities, however, the major portion of the populations of these countries will live in rural areas. The greatest attention must be paid to urban problems in developed countries, but the foremost problems of transport and communications in developing societies are in the rural domain. Is there, nevertheless, any way in which the solutions to urban and rural problems in developed and developing countries are similar? And what is the role of communications in the solution of these problems? The answer comes in the form of the telephone. The most obvious and perhaps the only direct substitute of communication for transport is when a telephone (or other telecommunication medium--teletype, telex, etc.) is used to transmit or receive information which otherwise would have required the time, inconvenience and expense of making a trip.² Whether in urban or rural situations, the telephone is the communication medium which can coordinate or obviate the use of transport facilities.

Very little research has been done on the effects of telephone usage on the attitudes and actions of the users. Social scientists with an interest in communications have given it scant attention. Perhaps its effects have been considered less significant and therefore less deserving of research than those

¹Ibid., p. 155.

²F. W. Memmott, 3rd, "The Substitutability of Communications for Transportation," Traffic Engineering, February 1962, pp. 20-25.

of the mass media. Perhaps, because in the United States it has been for so long "ubiquitous," as the advertisement said, it has been merely taken for granted. In 1964 there were 44 telephones for every 100 people in the United States. The total number of telephones in the U.S. that year was 84 million or 49.4% of the world's total (see Table 15). Even in the United States, however, there is something of an urban-rural split on telephone availability: while 80% of urban-metropolitan households have telephones, only 45.5% of rural-farm households do. Nevertheless, it was estimated that in 1959 36.5 million households in the U.S. had telephones, while only 14 million did not.¹ It may be assumed that few people could be found in the U.S. who have never used a telephone; many use it daily--in 1963 there was an average of 570 telephone conversations for each person in the country. The telephone has clearly had a profound effect on the lives of Americans.

The situation in developing countries has been quite different. In all of Asia there are only 15.5 million telephones, of which more than 10 million are in Japan. This leaves 5 million telephones for all other Asian countries, including the world's two most populous--India and China. Similarly, in all of Africa, where there is a population approximately equal to that of the United States, there are only 2.7 million telephones for a telephone density (# of telephones/100 of population) of 0.8, as compared with a density of 44 in the U.S. Nearly half of the telephones on the African continent are located in South

¹E. A. MacNeal, "The Telephone Household: A Profile," Public Utilities Fortnightly, Vol. 64, October 22, 1959, pp. 681-685.

Africa. For comparative purposes the number of telephones and telephone densities by continent are given in Tables 15 and 16, respectively, for selected years since 1914.¹

Not only are telephones scarce in developing countries, but the ones which do exist are usually concentrated in the capital and perhaps one or two other major cities. This has produced a pronounced urban-rural split in telecommunication availability. For the most part these telephones, beginning in the colonial era, have been installed to provide for governmental and then commercial needs. The result has been that in Senegal, for instance, 80% of the telephones are in Dakar and in Kenya 51% are in Nairobi. Teich notes that in Pakistan only high civil servants are given personal telephones, which are removed upon their retirement. Graph 1 shows how the percentage of telephones in certain major urban areas compares to the percentage of the population living there for selected countries, which are ranked in order of increasing overall telephone density. It illustrates that the lower the telephone density is within a country the more likely that country is to have a disproportionately high percentage of the telephones (compared to the percentage of population) in urban areas.

Showing that the developed countries have more telephones than the underdeveloped does not, however, prove that they are

¹The tables, graph (following), and statistics are quoted from A. H. Teich, "The Telephone in the Social System," unpublished manuscript, Political Science Department, M.I.T., which used as a source American Telephone and Telegraph Company, The World's Telephones, 1964, New York, 1964.

Table 15. Number of Telephones, by Continent

	<u>1964</u>	<u>1953</u>	<u>1938</u>	<u>1930</u>	<u>1921</u>	<u>1914</u>
North America	90,831,400	51,430,400	21,050,021 627,400	21,695,376	14,302,063	10,120,948
Middle America	1,389,000					
South America	3,872,800	2,094,800	835,407	587,121	286,950	166,331
Europe	53,377,600	23,785,100	14,269,230	10,035,580	5,289,606	4,012,709
Africa	2,241,500	1,084,300	373,255	236,108	102,200	65,096
Asia	15,475,400	3,268,000	1,281,191	1,201,008	493,640	306,085
Oceania*	3,812,300	1,910,000	895,965	771,436	376,080	217,391
WORLD TOTAL	171,000,000	84,200,000	39,245,069	34,526,529	20,850,550	14,888,550

* Includes Philippines for 1938 and earlier; Philippines included in Asia for 1953, 1964.

(Source: American Telephone and Telegraph Company, The World's Telephones, 1964, New York, 1964.)

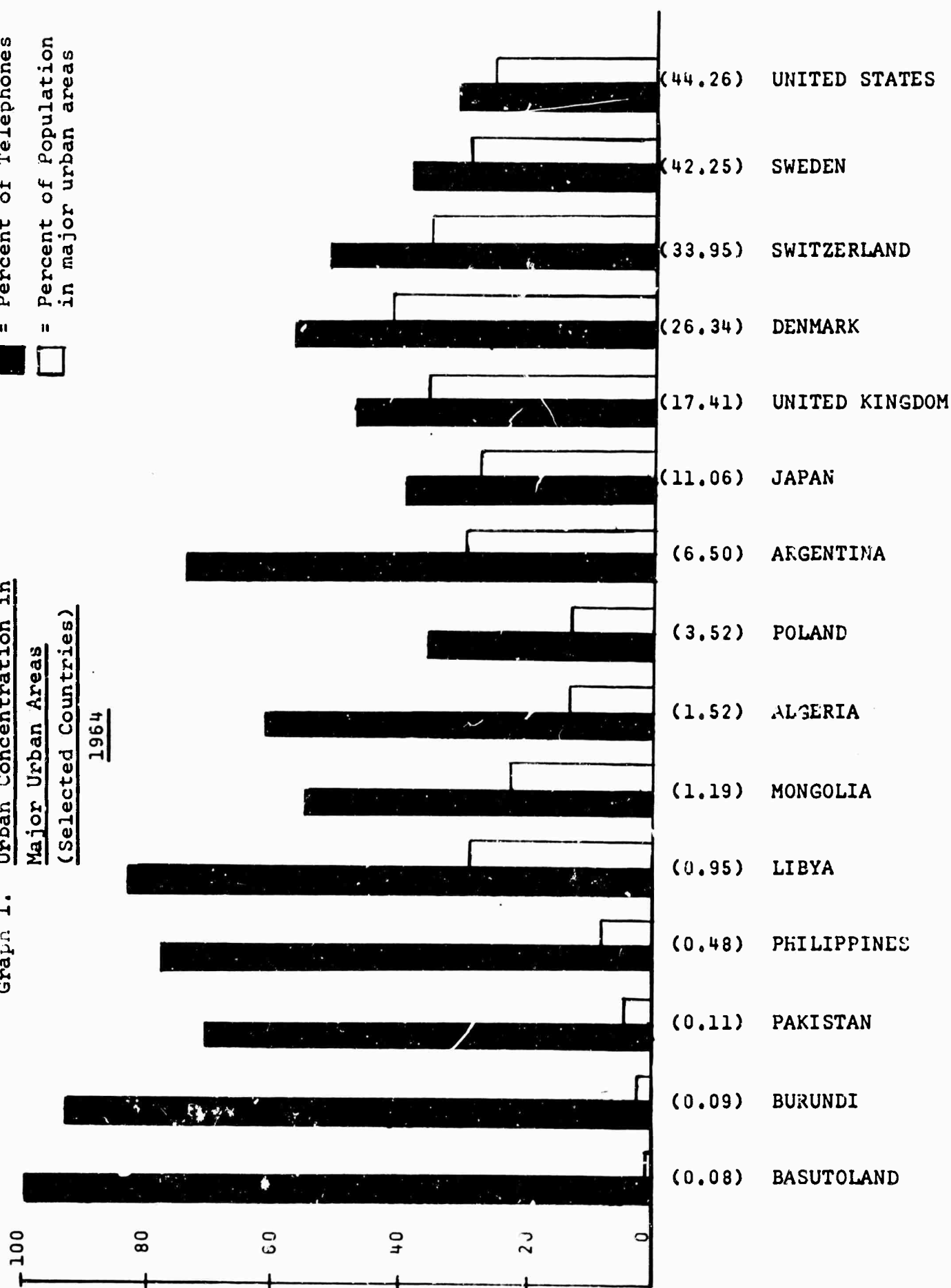
Table 16. Telephones Per 100 Population, by Continent

	<u>1964</u>	<u>1953</u>	<u>1938</u>	<u>1930</u>	<u>1921</u>	<u>1914</u>
North America	43.9	29.7				
Middle America	1.9	1.2	11.68	13.0	9.8	7.5
South America	2.5	1.8	0.86	0.7	0.4	0.3
Europe	8.7	4.0	2.47	1.9	1.2	0.8
Africa	0.8	0.5	0.24	0.2	0.1	0.05
Asia	0.8	0.2	0.17	0.1	0.1	0.04
Oceania*	21.2	12.2	0.93	1.0	0.6	0.4
WORLD TOTAL	5.3	3.4	1.79	1.8	1.2	0.9

* See note in Table 15.

Graph 1. Urban Concentration in
Major Urban Areas
(Selected Countries)
1964

■ = Percent of Telephones
□ = Percent of Population
in major urban areas



necessary or desirable. A country's lack of telephones does not in itself justify expenditure on telecommunications instead of on transport because, as Pool has observed, "that which is ubiquitous at all times may not be of any interest. Communication is significant if it acts in a variable way upon the social events of which it is a part, not if it appears as a universal constant with no operational effect upon the interrelations of other social phenomena."¹

The telephone serves communications needs in five spheres: 1) social, 2) commercial, 3) governmental, 4) security, and 5) generally, informational. Little research, it was noted above, has been done on the effects of telephone availability, but in each of these spheres of telephone usage the making of a single telephone call has stimulated a change, no matter how slight, in the actions or attitudes of both parties because of the information that was transmitted or received. In some areas the effects are more measurable than in others. Any call that saves a trip produces quantifiable saving in terms of travel expenses, vehicle depreciation, time spent, etc., which can be weighed against installation and operating costs for the telephone itself. Numerous examples of the beneficial effect on making commercial decisions of having telephones available can be found in each person's daily life. This is obvious. But in what way can it apply to the lives of rural villages in developing countries?

¹I. Pool, "The Role of Communication in the Process of Modernization and Technological Change," in B. F. Hoselitz and W. E. Moore, Eds., Industrialization and Society, UNESCO, 1963.

The information-providing function is an important one in any society. Schramm says that "the tribe had to post a watchman to scan the horizon and report on dangers and opportunities."¹ When his time came to report surely the watchman was the focal point for disseminating information about the unexpected and unfamiliar. This may be why Frey found in the Turkish survey that "about 40% of all groups--the modal frequency--saw the improbable village watchman-messenger (bekci) as the person who most often introduced new ways of doing things....The muhtar (headman) and the teacher were the other persons prominently cited."² For one person in a village to have such access to a telephone could clearly lead to a position of power for him as a "gatekeeper" in control of the flow of information. Providing the use of the telephone to any one or more than one villager could very easily be envisioned to extend the innovational role which previously only the watchman or other person with constant contact with the outside world has had. The telephone may therefore merit far greater appreciation than it so far has as a means for invoking change in rural societies. It can provide communication in situations when travel is arduous or impossible. It may help, as suggested in Part B of the Conclusion, in augmenting other programs of village development.

B. Two-Way Radio in Nepal and East Pakistan

If the telephone is to receive more consideration than it

¹Schramm, Mass Media and National Development, p. 38.

²F.W. Frey, "Rural Development Research Project--Preliminary Report," M.I.T., p. 24.

has in the past in development planning, there must be accessible information on its costs and usage. There are two methods for obtaining this information. One is to look at generalized cost estimates for systems which with only minor modifications could be installed in any location. This will be done for one system in Part C, which follows.

The second method is to look at projects which have been planned or carried out in some developing countries. This will be done here (Part B) for Nepal and East Pakistan. The examples of Nepal and East Pakistan represent something of the "macro" or, at least, the sub-system approach to planning telephone installation. For even larger-scale telephone system installation plans in developing countries, the reader is referred to those for Guinea and Nigeria, which are not discussed here because they are designed mainly for dealing with larger volumes of traffic.¹

Nepal

In 1964 a communications system based almost entirely on the use of two-way radio was inaugurated in Nepal. Radio-telephone is ideal for Nepal because of the low level of traffic and because the mountainous geography makes the stringing of wires impossible.

¹Page Communications Engineers, Inc., Telecommunications Study of the Republic of Guinea, 1964; and 2) Western Electric Company, Republic of Nigeria Telecommunications Study (2 vols.), 1963; both prepared for the U.S. Agency for International Development, Washington, D.C.

The U.S. Agency for International Development paid for almost all of the equipment, including local materials, installation and construction. The total cost of the project was \$2,170,000, of which the U.S. provided \$2,041,000, the Nepalese Government the equivalent of \$96,000, and the Indian Government the equivalent of \$33,000.¹

The Nepalese communication system is composed of

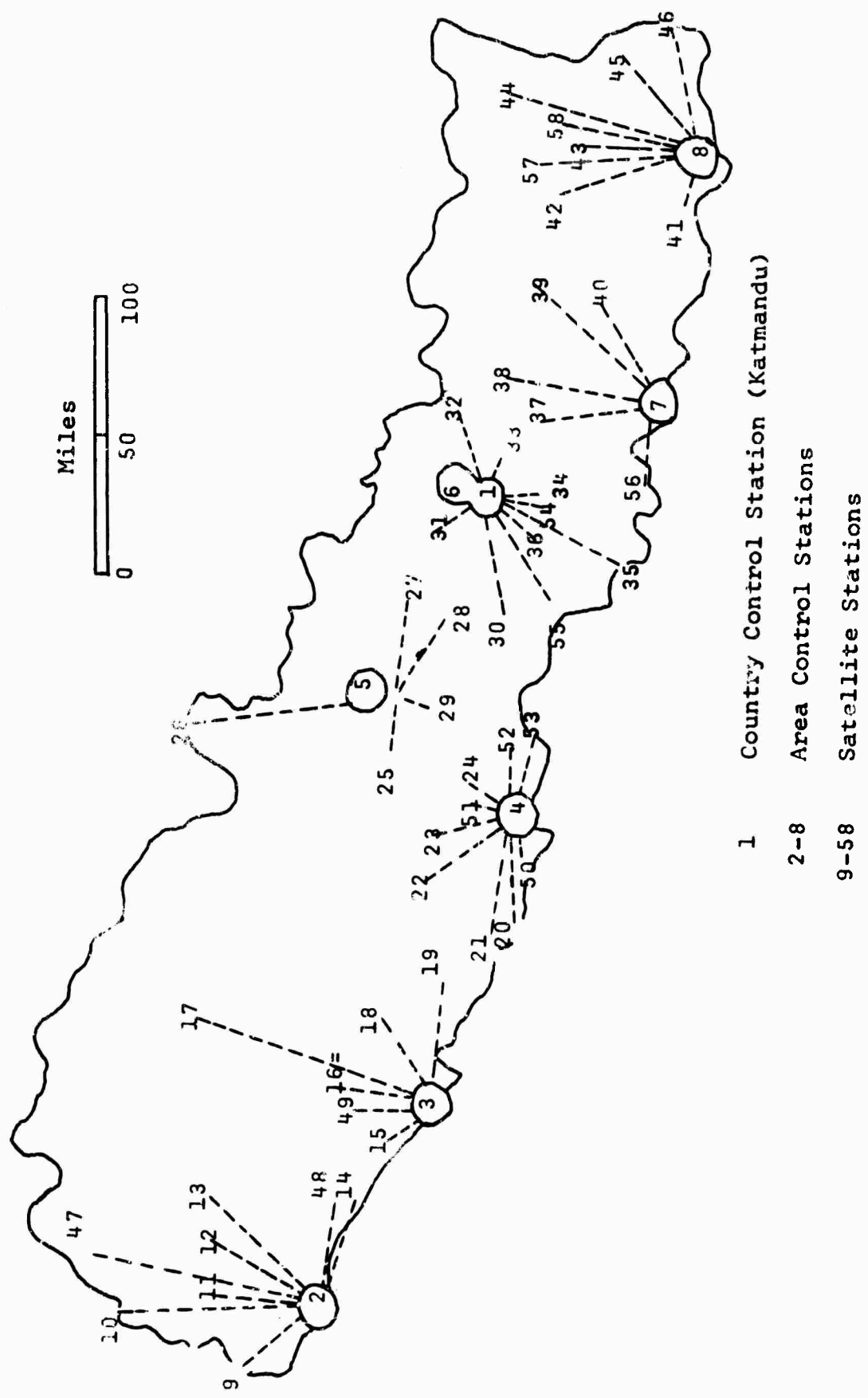
1. an internal telephone and telegraph system consisting of one country control station, seven area control stations, and fifty satellite stations (see Illustration);
2. a 1,000-line central telephone exchange in the capital (Katmandu); and
3. two radio links for international telephones and telegraph.

For extra-territorial communication one of the two international links connects with Calcutta and then, through the Indian Overseas Communication System, to world-wide service. The second international link goes to New Delhi and was first used in November 1963 to transmit on All-India Radio coverage of the visit to Nepal of India's President, Dr. Sarvepalli Radhakrishnan.

Internally the system is set up so that each of the seven area control stations has six to nine of the fifty satellite stations reporting to it. As can be seen from the Figure, the normal range of distances of satellite stations from area control stations is essentially 20 to 70 miles. As two-way radio is line-of-sight, it is assumed that the locations of satellite

¹Information about this project was provided by Mr. M. I. Molinari, Business and Defense Services Administration, U.S. Department of Commerce, Washington, D.C.

Illustration 5. Two-Way Radio Communication System in Nepal



stations were dictated in part by considerations of relative heights within the mountain ranges. Many of the stations were so inaccessible that equipment and technicians had to be ferried in by helicopter.

The problems of transport and installation had a considerable effect on the costs involved. The units used for the fifty satellite stations were RCA Mark IV two-way radios, which cost approximately \$1200. The installed cost for each of these units, however, was estimated to be about \$5000. Each station is equipped with one two-way radio, an antenna and a generator. When they began operating, each station was equipped with two years' supply of spare parts and 20 gallons of diesel fuel.

The system has been set up to link all the political districts as well as the main centers of industry and trade. For these purposes it has a political, administrative and economic effect which the Nepalese Government apparently felt fully justified the use of the limited foreign aid resources available to them. Although current information on the economics of running the system is not available, efforts are being made to make the system as profitable as possible. To insure this, the hours of operation are regulated in accordance with the volume demands of the traffic.

Secondly, for operation and maintenance of the system a great deal of emphasis has been placed on having trained personnel. Initially, approximately 250 persons were trained to staff the system, including 141 radio operators, 52 radio m-

pair and maintenance technicians, 25 telephone operators and 33 telephone inside and outside repair men. A fairly large staff is kept at the country control station in Katmandu; for each of the satellite stations there are only two operators, so that they rely for repairs and maintenance on technical help from the area control stations. Each of the area controls thus has been manned with three radio operators, a chief radio technician and five other radio technicians.

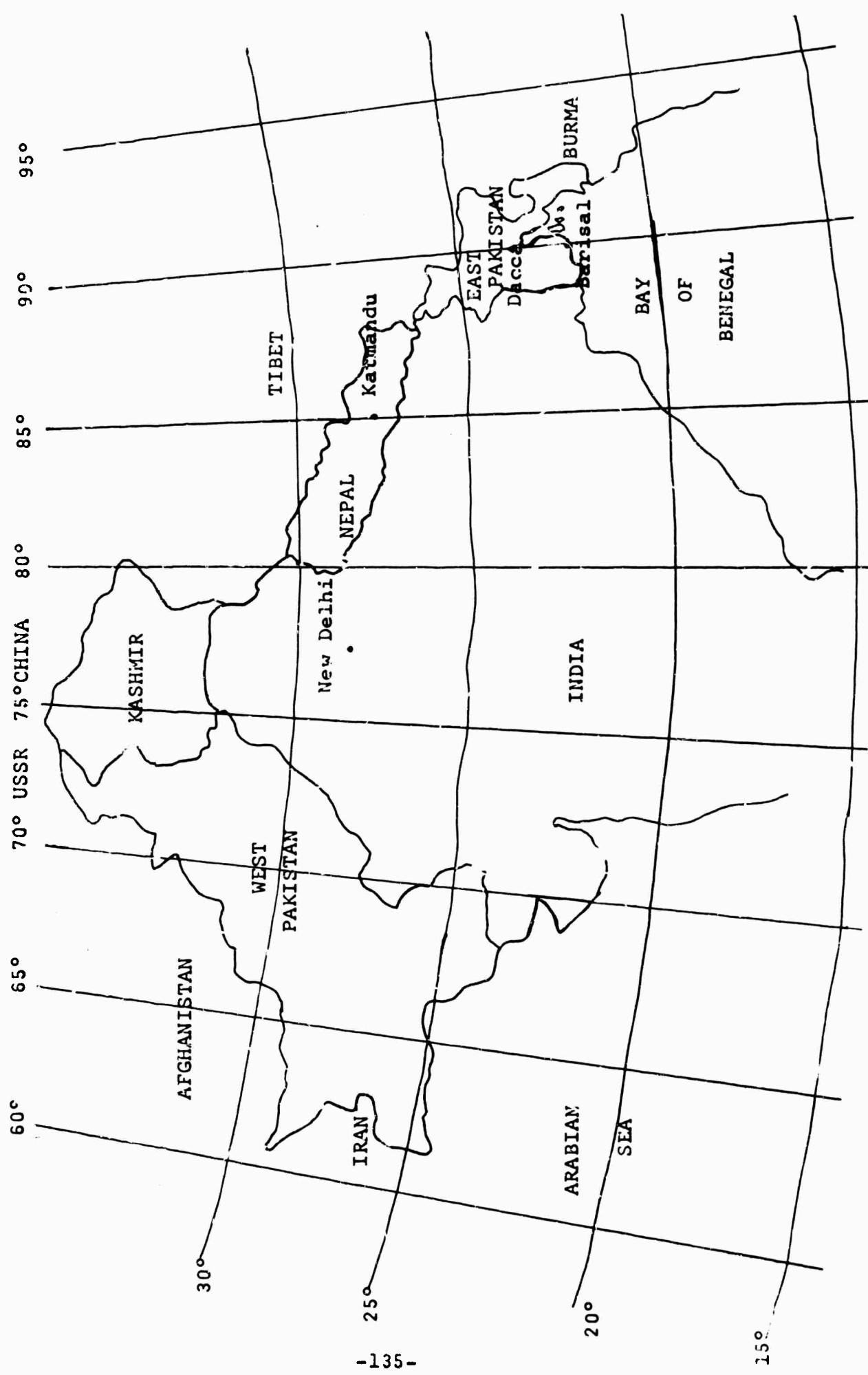
Now that the system has become operational, efforts are being made to expand and refine it. The American technical adviser was quoted as saying that "there is a tremendous possibility of commercial utilization, and I foresee (the) Government's making a profit from it. With the money so made, the system can be expanded to meet the growing needs of the people."

East Pakistan

The Barisal District of East Pakistan (see Illustration 6) is an area where telephone communication can be vital in averting disaster, which comes in the form of cyclones and floods and thus prohibits the use of wire and cable. In addition, the area is one of delta lands with a myriad of streams which are forever changing their paths. Under these conditions radio-telephone can be the answer to the communications requirements.

The Barisal District was chosen as the area to be studied for a pilot project which would ultimately be the basis for developing a telecommunications system throughout all of East

Illustration 6, Map of South Asia



Pakistan. The study was made in 1961 and, although it has not yet been carried out for reasons of limited resources, it is a good illustration of the organization and costs involved in setting up a two-way radio system of communication.¹

Following the administrative break-down of the district, radio-telephone would connect all Thanas and all Union Councils. There are 34 Thanas in Barisal District and 327 Union Councils, of which 21 are in urban areas. The population of the district is about 5,000,000.

Design of the system required a balancing of three considerations. First, the system must be highly reliable during the cyclone season so that adequate warning and information can be carried before, during and after a cyclone; second, the Government must be able to maintain contact along official channels from Dacca (the capital of East Pakistan) to the District, Thana, and Union Council levels, as far as practical; and, third, the system must be supportable through commercial usage.

In order to achieve the third objective it was decided that each Union Council which had a telephone for official use would have one also for coin-operated public use. The two telephones would use the same line, with the official phone being able to cut in whenever necessary.

¹THACE, Inc., "Barisal District, East Pakistan, Pilot Telecommunications Project and Reconnaissance Report," 1961, Office of Engineering, U.S. Agency for International Development, Washington, D.C.

It was anticipated that the Union Council telephone would not become a paying proposition until the people realized its advantages, which would take at least three to five years. Those who have used telephones so far have found the service to be quite poor, and this is felt to have discouraged the development of a large clientele.

While the service to be given must therefore be of high quality, and only the highest quality U.S. equipment (at U.S. prices) would be used, it was shown that by reducing system reliability by only 2%, from 99.9% to 98%, equipment costs can be reduced by as much as one half. An RCA CW20 terminal unit at \$11,000, for instance, can be substituted for an RCA MM300, which costs \$22,000.

The basic system which was laid out is shown in Illustration 7. The double lines are the grid formed by the connection of major points in the District by means of 12-channel radio telephones. Most of these "hops" fall in the range of 20-25 miles. The cost for the system shown in Illustration 7 is given in summary form as follows:

Table 17. Proposed Cost of Barisal Communications System
(Total System)

Equipment F.A.S. New York	\$2,235,550
Ocean Freight	110,000
Training	180,000
Supervision of Installation	400,000
Spares	150,000
Total U.S.	<u>\$3,075,550</u>
Local Construction Cost	1,100,000
Total	<u>\$4,175,550</u>

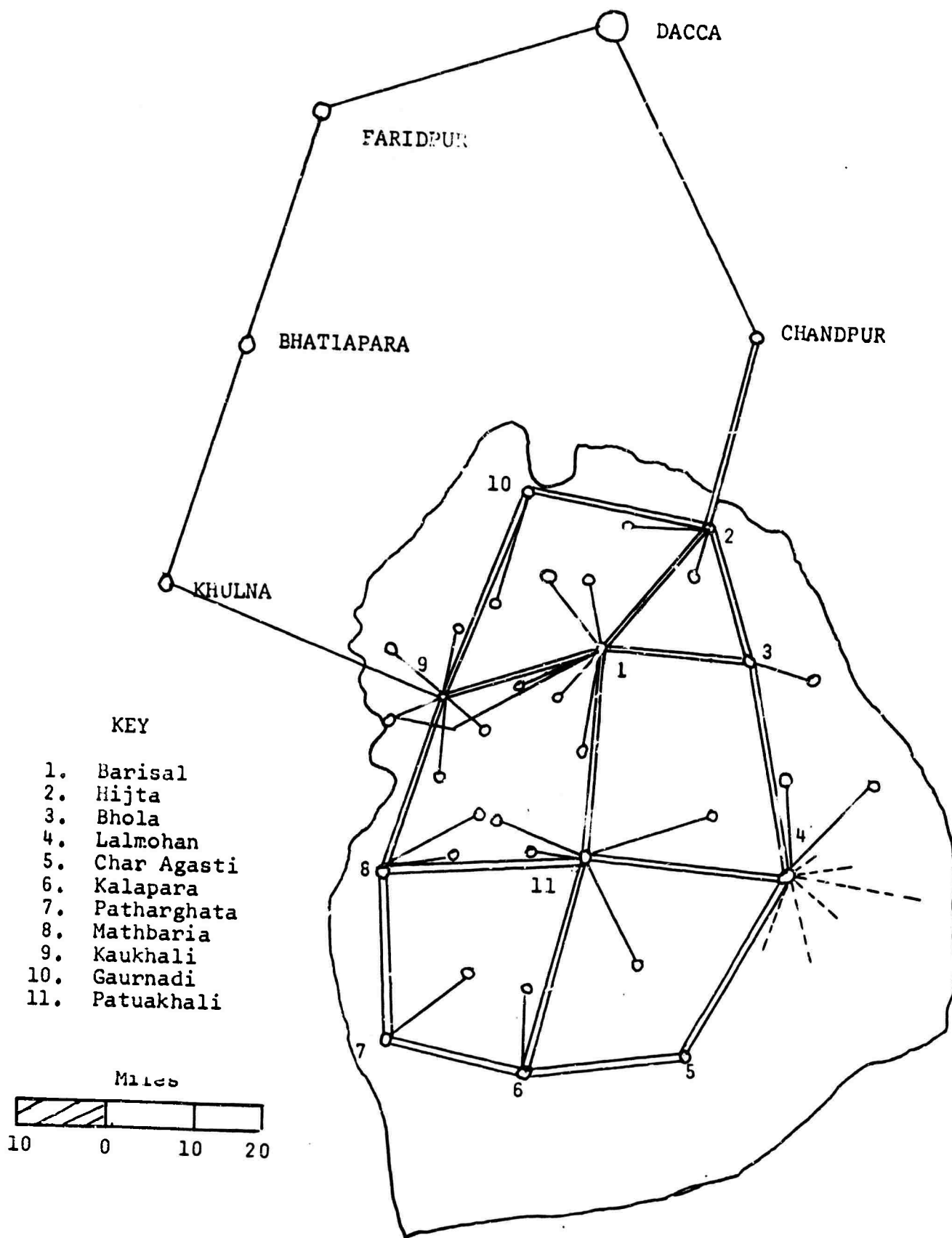


Illustration 7. Barisal District
Two-Way Radio Grid

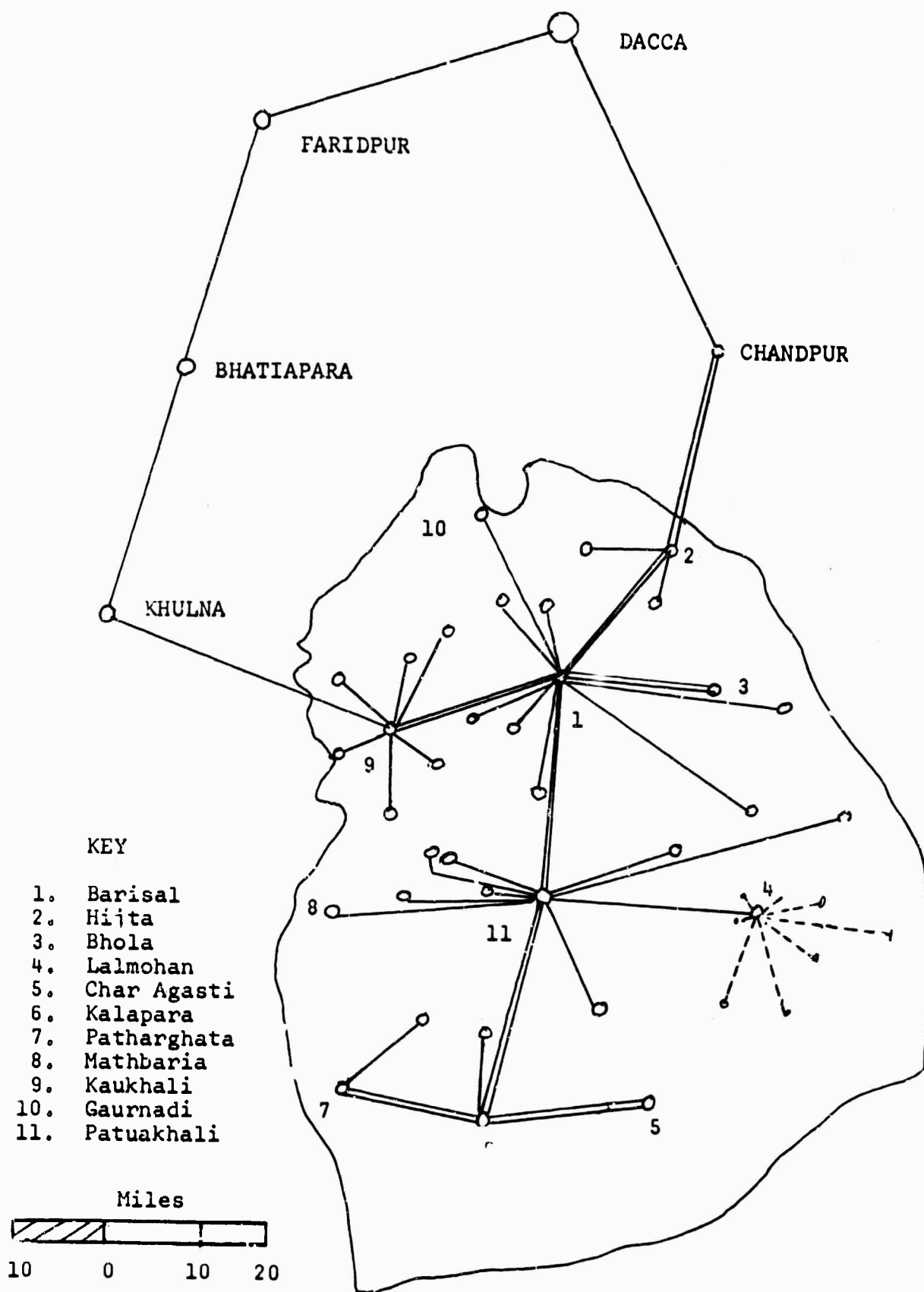


Illustration 8. Barisal District
(Reduced) Two-Way Radio Grid

A second (reduced) initial system at a much lower cost was also proposed. This system is shown in Illustration 8. It is exactly the same as the first system except that the grid of interconnecting links between major points has been eliminated. This reduces the reliability of the system because it eliminates the availability of alternate routes, but it reduces the costs by \$1,500,000. For the system the costs would be as follows:

Table 18. Proposed Cost of Barisal Communications System
(Reduced System)

Equipment F.A.S. New York	\$1,855,930
Ocean Freight	50,000
Training	80,000
Supervision of Installation	150,000
Spares	60,000
Total U.S.	<u>\$2,195,930</u>
Local Construction Cost	500,000
Total	<u>\$2,695,930</u>

Costs for the component units of equipment are given as follows:

Table 19. Telephone Equipment Unit Costs

<u>Unit</u>	<u>Cost</u>
1. Teletype terminal	\$ 125
2. Telephone terminal	200
3. Speech & Duplex	200
4. 60 Channel radio relay terminal	5,000
5. 24 Channel radio relay terminal	5,000
6. 12 Channel radio relay terminal	5,000
7. 2 Char .1 radio relay terminal	1,300

Table 19 continued

<u>Unit</u>	<u>Cost</u>
8. Union Council radio relay terminal	\$ 200
9. Thana Base radio telephone	1,000
10. Antennas (Thanas and up)	910
11. Towers (guyed)--approximate original cost	1,500
12. Exchange lines less telephones	200
13. Coin telephones	150
14. Dial telephones	30
15. Radio trunk switches	235
16. a) Power-Diesel generators (5 kw)	2,500
b) Power-Diesel generators (7.5 kw)	3,500
c) Power-Diesel generators (15 kw)	4,500
17. Power storage batteries	25
18. Buildings (pre-fab, at Thanas)	2,000

The base stations would have full duplex (normal telephone) operation. The Union Councils, however, would have either "push to talk" operation or simplex operation (in which the line goes dead if both people try to talk at once).

It was considered that, if the initial total system were used, very little additional cost would be required to send radio over the grid between the eleven major base stations where it could then be picked up by low power transmitters and re-broadcast to nearby areas.

Planning for the system has been on a 20-year scale, and, if the initial system were the reduced one, it would be built up so that it would be the same as the total system plus what its projected growth would be in fifteen years. As growth takes place, a "replacement-down" process can be carried out with units of larger circuit capacity replacing old units which are then

installed in smaller administrative areas. This is an advantage of using radio-telephone. If wires are used, either much greater initial capacity must be provided, or virtual reconstruction of the system must be carried out in an expansion program.

As an example of how replacement-down could work, it was felt that initially not all the Union Councils would require their own telephone because often a few are located quite near to each other. Telephone traffic may warrant placing telephones in only one-half to three-quarters of the Union Councils, with the remainder close enough to have use of the instruments.

The Union Council equipment would consist of

1. one telephone desk set for the Union Council official calls;
2. one coin operated telephone for public use;
3. equipment for dialing through and receiving ringing from the Thana Base Station and central office equipment;
4. controls and accessories consisting of a hand set and dialing instrument, one-off key switch with indicators for power on, transmitter on, and busy circuit condition; a bell would be provided to sound at intervals similar to land line operation;
5. a switch so that the official phone can cut in and take over the single circuit.

The Thana Base Station would be equipped with an unattended dial station selector to provide, on the party-line dial phone, for selectively signalling and talking to other places. This would make it possible for communication to take place between the Thana and each of its Union Councils, and between any of

the Union Councils within the Thana. Thanas would be connected with the eleven major Grid Base Stations by a 12-channel link.

The coin-operated telephones would offer unattended service for the sum of 5 cents for a local call. For any calls other than local (which would be an approximately 25 mile radius), the calls would be routed through the toll operator at the main station in Barisal.

It was found that the average yearly income for public coin telephones in Pakistan would be sufficient to amortize the service over about five years. Counting on an annual income of only \$300 per new phone, however, which is only about one-third of the revenue received on the other (already installed) phones, amortization could take place over a twenty-year period. It was also felt that economies could be made by streamlining service. East Pakistan employed 400 people to provide the service of 16,000 telephones then in existence; this number could be reduced to about 20 people.

Cost considerations, however, show that many new phones would have to be added to the new system once it is constructed. For the large-scale initial system of 3,700 telephones, the revenue (figured at \$135 per telephone--\$95 from local service and \$40 from long distance service) would be only about \$500,000. Teletype and telegraph would bring in an additional 25% of that amount, or \$125,000, for a total revenue of \$625,000. Yearly expenses for operating, maintenance, interest and amortization, based on world-wide telephone industry experience, would be about 28.5% of the total installed cost of

\$4.2 million, or about \$1.2 million, for a deficit of \$575,000.

The installation of 8,000 new phones would be required to make a profit. Installed cost of each new telephone would be \$300 for a total of \$2,400,000. Twenty-eight and a half per cent of the new total installed cost (\$4.2 million plus \$2.4 million) is about \$1.9 million; total telephones of 11,700 with a revenue of \$135 each plus 25% for message traffic is approximately \$2 million--for a net profit of \$100,000 per year.

The revenue per telephone was arrived at 1) by assuming, on the basis of traffic in similar countries, that there would be 50 toll calls per telephone per year, but also 2) by using an accepted estimating method based on the size of the exchange, as follows:

<u>Size of exchange</u>	<u>Number of long distance calls per year per telephone</u>
up to 500	72
500 to 5,000	48
5,000 to 10,000	36
10,000 and over	24

In the Barisal system there would be 2,000 telephones in the 500 to 5,000 range and 1,700 telephones in the "up to 500" range, for an average of 59 calls per year per telephone.

The recommended toll charges for 3 minutes are:

<u>Distance</u>	<u>Cost</u>
25-49 miles	\$0.15
50-99	0.30
100-199	0.55
200-299	0.80
300-399	1.00
etc.	

The average length of calls was estimated to be about 4 minutes and the average cost as \$0.70 (all calls under 3 minutes being charged the 3 minute rate). Sixty toll calls per telephone per year at \$0.70 per call gives a toll revenue of about \$40 per telephone per year, as noted above.

It was assumed that the installation of the close to 8,000 telephones needed to make the system show a profit would be carried out over a period of about 15 years. The 20-year total of 15,000 telephones was calculated to give the very conservative telephone density of 0.5.

By installing the reduced initial system, it was calculated that net operational profits would overcome expansion and operating costs in the tenth year, all deficits would be wiped out in the fifteenth year, and in the twentieth year the accrued clear profit would be about \$6 million. This system is the one which was recommended for installation.

C. Rural Two-Way Radio for Developing Countries

The systems described above have given an idea of the planning involved in setting up a telephone system and some feeling for the costs involved. But what can those responsible for development in a given area of an unspecified developing country do if they feel that telephones may benefit that locale? What if that area were typified by the "average" situation depicted in Chapter I, of a single village about 30 miles from a nearby small city, and they wanted to install a single telephone connection between the village and the city?

7. Two Alternatives

Because the telephone traffic between such a village and city is likely to be quite low, the connection would probably consist of a single line, which may be formed either by stringing telephone lines or by installing a two-way radio.

The basic cost for installing a single telephone line can be estimated fairly easily. The most appropriate wire would probably be "Rural C" which has been in use in rural areas of the United States for the past five to six years, and has a life expectancy of about 20 years. It is a copper-weld (copper jacket over steel cord) wire with polyethylene insulation and jacket, and the Copperweld Corporation in Pennsylvania is the only U.S. producer. It is designed for use under any environmental conditions found in the U.S., and therefore could be assumed to be appropriate in almost any developing country.

The cost of this wire (which is actually a pair of wires) is \$50 for 1000 feet of 12 gauge wire which could be strung overhead, or \$150 for 1000 feet of wire (including two pair, for underground use) which can be buried. The cost for 30 miles of this wire would therefore vary from \$7,900 to \$23,700, exclusive of installation cost. As repeaters to strengthen the signal being sent are usually required about every 7 miles, three repeaters at about \$500 apiece would be required. The normal telephone instrument used in the U.S. costs \$25. Total equipment costs would therefore be a minimum of about \$9,400

for a single line.¹ In addition, it must be noted that even a single wire line that is properly maintained usually has a maintenance cost equal to the capital cost every 2-4 years.²

Besides its cost Laport notes that a 30-mile wire line should always be excluded for reasons of security from sabotage or pilferage of material, for its need of constant maintenance effort and expense, and its vulnerability to danger from the elements. He concludes that a 30-mile path in smooth terrain can be covered better and cheaper and have a greater system reliability by using a radio link in the VHF or UHF bands.

This conclusion was also reached by H. E. Weppler, who observed that it is generally cheaper to furnish service by VHF or UHF radio over a 30-mile distance than it is to construct a wire line--VHF or UHF radio referring to the type of 150 or 450 megacycle radio equipment used in various mobile radio services, although it was contended that maintenance and reliability factors usually favor the wire lines except in cases of extreme weather or terrain conditions.³

Weppler cautioned, however, that there are so many variables such as terrain factors, labor and power availability and costs and regulatory conditions, particularly in

¹Telephone equipment costs provided by the Boston office of the Graybar Electric Company, exclusive distributor of Western Electric Company telephone equipment to non-Bell Telephone System customers.

²Edmund A. Laport, Director, Communications Engineering, Radio Corporation of America, Princeton, New Jersey, personal communication, letter, July 19, 1955.

³H. E. Weppler, Radio Engineer, American Telephone and Telegraph Company, 195 Broadway, New York, New York, personal communication, letter, August 6, 1955.

developing countries, that it is necessary to have very specific detailed information on each situation before cost estimates can be made for any type of system which might be installed.

For use as a preliminary guidepost for the costs which might be expected in using a two-way radio, the following figures were obtained from the Canadian Marconi Company, Marine and Land Communications Division.

For coverage of a 30-mile distance, it is possible to install a 60 watt single channel base station in the city with a unidirectional antenna on a 100 foot tower. In the village would be a 25 watt mobile unit with a similar antenna and tower set-up.

The base station would be the company's DJ96 VHF unit with one to six channels, and the mobile unit model DT34 or DJ30 with one to four channels.

Costs for the equipment would be

Table 20. 25-Watt Village (Mobile) Unit Costs

1 channel	\$ 495
antenna	125
100 ft tower	475
hardware	100
microphone	40
coaxial cable @ \$0.12/ft.	---
	<u>\$1235 (min.)</u>

Table 21. 60-Watt City (Base) Station Costs

(1, 6) channel (s)	\$ 999, \$1435
antenna (unidirectional)	150
microphone	40
100 ft. tower	475
hardware	100
coaxial cable @ \$0.12/ft.	---
	<u>\$1764, \$2200 (min.)</u>

When the 6-channel base station is being used so that each of six villages on different frequencies can be called individually, an extra tone call system with call and busy lights can be installed with each mobile unit at a cost of \$180 apiece and an encoder to distinguish between the villages can be attached to the base station for \$105.

This type of installation is clearly of high quality--being rugged, having long life expectancy and, being transistorized, having low power drain. While being far cheaper than the wire line, it is, however, probably out of the reach of most villages to pay for out of their own funds.

2. Generalized Costs for Rural Two-Way Radio

Another method, however, is open for use in reducing the cost for villages of the normal two-way radio equipment. This is to make available to all villages within transmission range the use of a single base station, until capacity traffic load is encountered. This would have the primary effect of dividing the cost of a single base station among a number--perhaps a large number--of villages, and it would have the secondary

effect of lowering the manufacturer's offered price as more units are ordered because of the lowered cost per unit.

With this in mind, an attempt was made to overcome the problems of generality of terrain, climate and distance to define a range of costs which might have some applicability to a specific situation.

The range of a two-way radio depends to a large extent, for a given power output, on the height and directionality of the antenna. Directionality must be considered because the power required to transmit a certain distance increases as the directionality of the antenna decreases. Height is important because, while a tall antenna may have a high initial cost, savings are made in the long run because of lower power consumption by the unit.

If, for each base station, the number of villages which are to be connected will use the base station to capacity, both the number and location of these villages will vary in different terrains. As an example, in a tropical country there may be 30 villages within a distance of 30 miles and within a 30-degree arc from the city, which would use a single base station. Thus in that city there may be a large number of base stations to communicate with all the villages which surround it out to a given radius. As another example, in an arid country it might be found that a single base station could fulfill the needs of all of 100 villages out to a radius of 50 miles--thus using an omnidirectional antenna. An attempt has been made to estimate the costs for such a system in as generally-applicable terms as possible.

Since a high degree of performance and reliability is required for this service, the FM-VHF equipment offered by the manufacturers of two-way radio for the land mobile services is best suited to this application. It provides maximum useful range for a given power output and telephone quality voice reproduction, allowing recognition of voices.

Propagation

In considering the range of frequencies from 30 MC to 2 Kc as proposed in available CCIR documents,¹ 150 Mc was selected as it is virtually free from skip interference, and has less attenuation than higher frequencies, permits fully transistorized equipment with satisfactory RF power output at reasonable cost, and high gain antennas of reasonable dimensions.

The path attenuations for average terrain for various distances have been calculated using curves in FCC Report No. R-6502, dated April 26, 1965. These agree very closely for distances up to 50 miles with the CCIR curves in Recommendation 370, 1963. For rough terrain the criteria and increased attenuation figures were used from the CCIR Recommendation.

The degree of roughness is defined by the parameter, Δh , which is the difference between the elevations exceeded for

¹ Questions 276, 277 and 279 adopted at the C.C.I.R. General Meeting in Geneva in 1963, and the subsequent reports of the various study groups, particularly those of the United States study groups.

10% and the elevations exceeded for 90% of the propagation path in the range of 6 to 31 miles from the transmitter.

For average terrain $\Delta h = 50$ meters (164 feet).

For hilly terrain $\Delta h = 200-400$ meters (656-1312 feet).

The path attenuation has been corrected using Raleigh distribution curves to result in signal strengths that are exceeded at 50% of the locations for 99% of the time. Since the exact location of the village antenna can be selected to give a good signal level, the suggested system should give reliable operation.

For hilly terrain actual systems may well have lower attenuation than indicated by the average data since it is often possible to locate either the city antenna or the village antenna or both on a hill and get the advantage of greater effective height. In designing a specific system in hilly terrain profiles should be drawn to each village to be provided with a station and the path attenuation calculated for these.

No separate data will be shown for desert and tropical locations since CCIR-USPC-IXB Working Document No. 5 shows that the attenuation for these climates are about 2 db more or less respectively than that for temperate climate, and this is within the limits of error of the determination of propagation losses for paths of the lengths we are considering.

Dense jungles present a special problem due to the attenuation offered by foliage. The attenuation increases with frequency especially for frequencies above 150 Mc.

The antenna masts at both ends of the circuit should be located in large cleared areas or be high enough to place the antennas well above the tree tops. In such areas 50 Mc might be desirable to be used despite the greater susceptibility to skip interference.

The cost data given below will not show the cost of a city base station referenced to maximum range from the city, since the objective is to keep the cost of the village installation to a minimum, therefore the city installation would remain the same in all cases and the antenna height and gain of the village stations would be reduced as the maximum range is reduced.

Propagation has been calculated on the basis of no man-made electrical interference due to industrial plants or automotive traffic. Such electrical noise would, if present, require increased signal strength for satisfactory communications.

Equipment

For both the city and village stations narrow band (± 5 Kc deviation) FM fully transistorized equipment is assumed operating in the 150 Mc band with a power output of 8 watts and a receiver sensitivity of $0.3 \mu\text{v}$ for 12 db Sinad (ratio of signal + noise + distortion to noise + distortion). Power output is limited to 8 watts to reduce the size of the battery or power source required to operate the stations. Transistorized signalling equipment would be provided to accom-

plish the signalling functions which will be covered in the next section.

Duplex operations would be used, with the transmitters being keyed when the handsets are lifted off the cradle, obviating the need for push to talk operation. Seven Mc separation of the two frequencies to be used is recommended. A duplexer would be used at the city station. For the village stations at the shorter ranges separate receive and transmit antennas are used, for the longer ranges cost considerations call for a single antenna and a duplexer.

Signalling Requirements

Selective calling of individual village stations would be accomplished with pulsed audio tones within the pass band of the equipment, using two tone codes to select the proper receiver. The cost will be based on a system that can select 100 stations.

Lock-out protects against interference in conversations by a person at another village station lifting the hand set and thereby sending out a carrier that might capture the city receiver or at least cause interference. It is desirable to provide lock-out of all stations except the city station and the village station in communication with it. It is proposed to do this using tones below the normal voice band, i.e., below 300 cps, which are transmitted continuously when the carrier is on, and are filtered out of the receiver output.

This lock-out feature would be in effect irrespective of whether the call was initiated from the city or village station.

The lock-out circuitry would also provide that when a village station initiated a call the lock-out tone from the city station would cause a talk lamp to light indicating that the circuit was complete.

In accordance with the recommendation of CCIR-USPC-IXB Working Document No. 5 provision is made for a supervisory test. The operator at the city station can select a station, press a button, and send out a test tone.

If the station selected received the signal and is operative the test tone will cause the transmitter to be keyed and return a test tone to the city station which will cause a lamp to light indicating the village station is operating normally. This signalling would also be done with tones below 300 cps.

No provision is made to send a further signal back to the village station to give an indication of its being out of order as this could only be done if the trouble was in its transmitter and not its receiver, and it does not appear that the value of this device justifies the added complexity.

No provision is made for the automatic identification of village stations when they initiate a call. Although technically feasible, this has been omitted in the interest of keeping the village stations cost as low as possible.

Antenna Masts and Antennas

Practical considerations lead to the antenna systems

listed below. All antenna gains are in db referenced to 0 db for a half-wave dipole. All coax cable is aluminum sheathed from cable--1/2 inch diameter.

Table 22. City Station Antenna Specifications

Antenna Height--100 ft. coax length 125 ft.			
<u>Antenna Coverage</u>	<u>Terrain</u>	<u>Antenna Type</u>	<u>Average Antenna Gain</u>
360°	Average	4 element folded dipole	6
360°	Hilly	4 element folded dipole (up to 20 miles)	6
360°	Hilly	8 element folded dipole (over 20 miles)	9
180°	Average	4 element folded dipole-- side mounted	8
180°	Hilly	8 element folded dipole off center pattern	11
90°	Average	4 element folded dipole directional	9
90°	Hilly	8 element folded dipole off center pattern	12
30°	Average	Double stack of 2-three element Yagis	13
30°	Hilly	Quadruple stack of 2-three element Yagis	15

Table 23. Village Station Antenna Specifications

Max Range	20 miles	30 miles	40 miles	50 miles
360°Average Terrain				
Mast Height	30 ft.	45 ft.	60 ft.	100 ft.
Rec. Antenna	2 3-element Yagis	2 3-element Yagis	4 3-element Yagis	4 3-element Yagis

Max Range	20 miles	30 miles	40 miles	50 miles
360° Average Terrain				
Trans. Antenna	2 3-element Yagis	2 3-element Yagis	4 3-element Yagis	4 3-element Yagis
Antenna Gain	10	10	13	16
Coax Cable	35 & 50 ft.	50 & 65 ft.	80 ft.	125 ft.
Duplexer	None	None	One	One

360° Hilly Terrain				
Mast Height	45 ft.	60 ft.	100 ft.	100 ft.
Rec. Antenna	same as for average terrain			8 3-element Yagis
Trans. Antenna				
Coax Cable	50 & 65 ft.	65 & 80 ft.	120 ft.	120 ft.
Duplexer	None	None	One	One

180° and 90°--Average Terrain				
Mast Height	30 ft.	45 ft.	80 ft.	100 ft.
Rec. Antenna	3-element	3-element	2 3-element	2 3-element
Trans. Antenna	Yagi	Yagi	Yagis	Yagis
Antenna Gain	7	7	10	10
Coax Cable	35 & 50 ft.	50 & 65 ft.	85 & 100 ft.	120 ft.
Duplexer	None	None	None	One

180° and 90°--Hilly Terrain				
Mast Height	45 ft.	60 ft.	100 ft.	100 ft.
Rec. Antenna	same as for average terrain			4 3-element Yagis
Trans. Antenna				
Antenna Gain	7	7	10	13
Coax Cable	50 & 65 ft.	65 & 80 ft.	105 & 120 ft.	120 ft.
Duplexer	None	None	None	One

30° Average Terrain				
Mast Height	30 ft.	30 ft.	45 ft.	60 ft.
Rec. Antenna	3-element Yagi	3-element Yagi	3-element Yagis	2 3-element Yagis
Trans. Antenna	folded Dipole	3-element Yagi	2 3-element Yagis	2 3-element Yagis

Max Range	20 miles	30 miles	40 miles	50 miles
30° Average Terrain				
Antenna Gain	7	7	10	10
Coax Cable	35 & 50 ft.	35 & 50 ft.	50 & 65 ft.	65 & 80 ft.
Duplexer	None	None	None	None
30° Hilly Terrain				
Mast Height	30 ft.	45 ft.	60 ft.	100 ft.
Rec. Antenna	3-element	3-element	2 3-element	2 3-element
Trans. Antenna	Yagi	Yagi	Yagis	Yagis
Antenna Gain	7	7	10	10
Coax Cable	35 & 50 ft.	50 & 65 ft.	65 & 80 ft.	105 & 120 ft.
Duplexer	None	None	None	None

Mast heights have been limited to 100 feet to facilitate erection, but higher masts for city stations could work further economies in the more remote village stations.

Power Requirements

To determine power requirements we must make some assumptions as to duty cycle. If there are sixty village stations in the system, on the average, the maximum time that each one could use the system would be 1.67%. For a 12-hour day this would be .2 hours per day. On the same basis the city station would operate 12 hours per day. If we assume 4 minutes holding time per call this would mean 3 calls per day per village. On this basis the village equipment would require 31 watt hours of energy per 24-hour day, and the city equipment 340 watt hour. per 24-hour day. The latter is approximately the energy storage capacity of a 12-volt auto storage battery. It is obvious that the city station would

require a primary power source, such as, a thermoelectric generator. The village station should preferably use a similar source, but could use large dry batteries. The power source should be 12/24 volts dc for maximum efficiency. Since there has been no criteria established for the frequency of use, type of power sources available, and lack of time to obtain quotations on suitable batteries and power sources, the cost of the power source has been omitted from the cost data provided in this report.

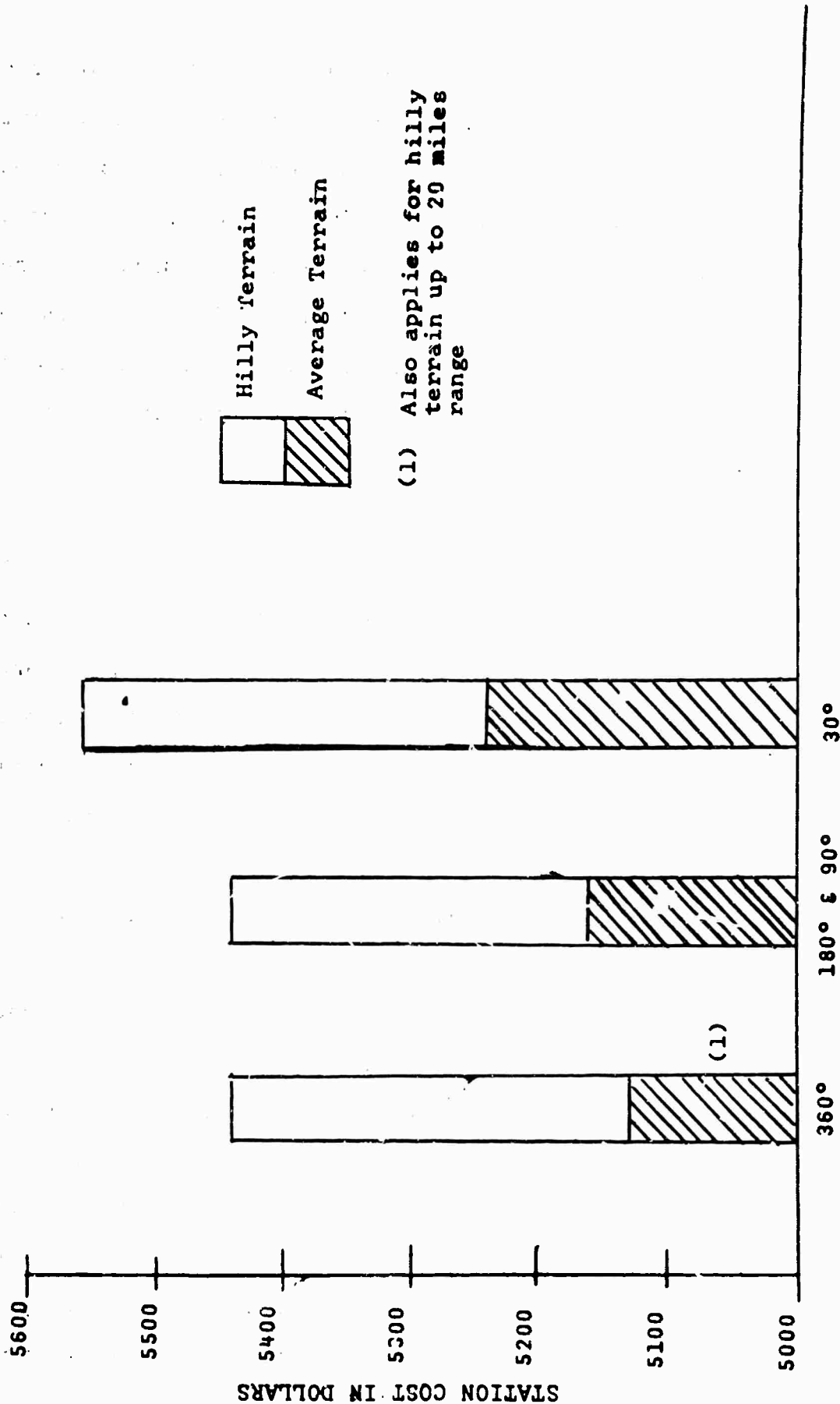
Budgetary Estimates of Cost

The costs shown on Graphs 2-4 are budgetary estimates only, firm prices could not be established until the system and equipment have been definitely specified. Although the radio equipment and the basic signalling modules on which these estimates are based are standard models, the packaging, switching circuitry and interconnections would require special design for this application. Definite quantities must therefore be assumed even for a budgetary estimate.

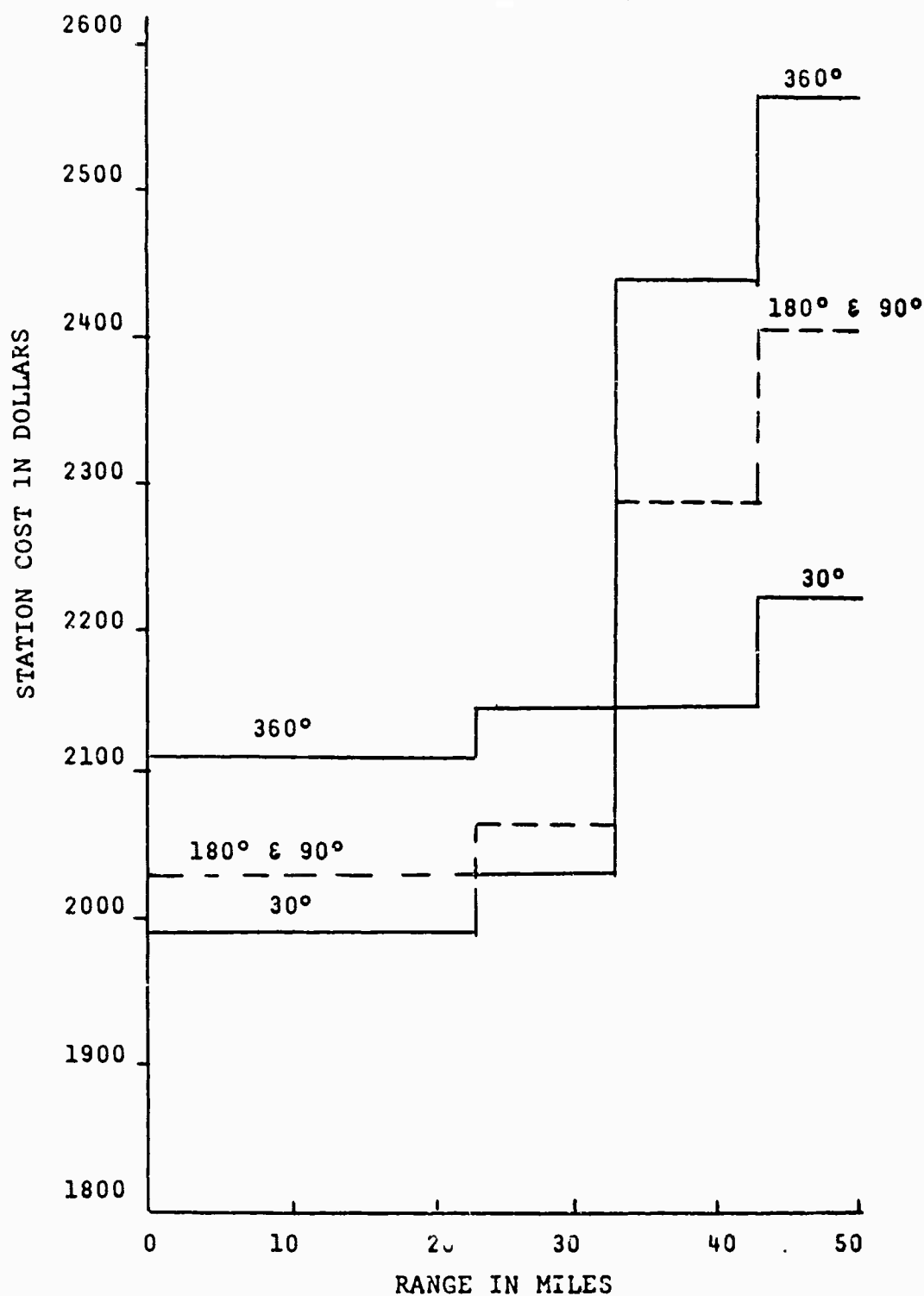
Despite the potential use of this equipment, from past experience it is probable that such systems would be procured one at a time, and the contractor would have no assurance when the next procurement would be made or if he would be the successful bidder. We have, therefore, based our estimate on the cost of building one city station and 60 village stations. The cost per city station would be measurably reduced if they were procured in quantities of at least 10 at one time. This could amount to 25%.

Graph 2. Two-Way Radio for Underdeveloped Countries

Budgetary Estimate - City Station Cost



Graph 3. Two-Way Radio for Underdeveloped Countries
 Budgetary Estimate - Village Station
 Average Terrain
 Cost vs. Range and Angle of Coverage



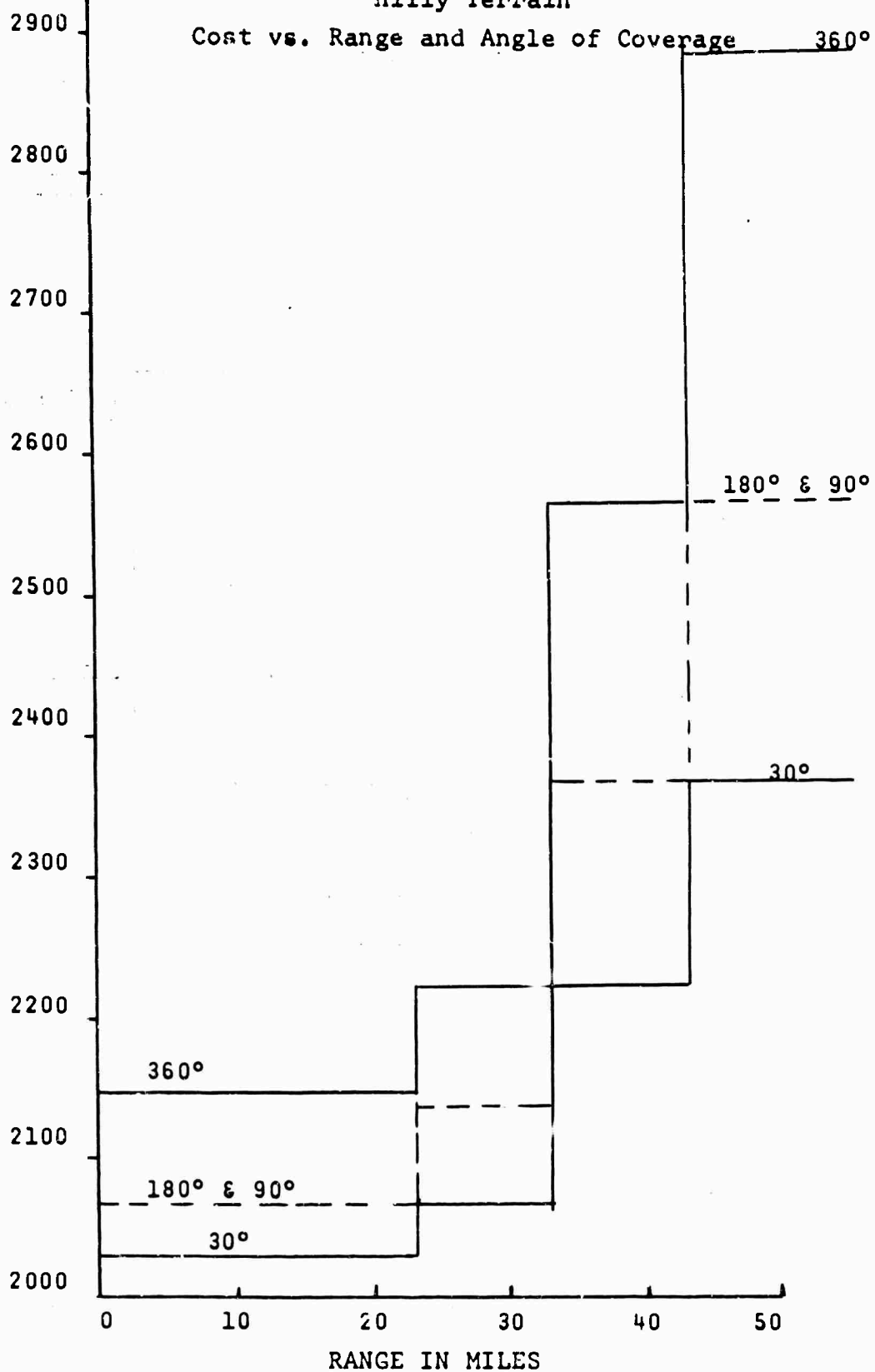
Graph 4. Two-Way Radio for Underdeveloped Countries

Budgetary Estimate - Village Station

Hilly Terrain

Cost vs. Range and Angle of Coverage

STATION COST IN DOLLARS



The cost per station shown on the charts includes the radio and switching equipment, the masts, antennas and coaxial cable, required to provide a telephone service from one location in the city to one location in each of the villages served. It does not include equipment to patch into a regular wired telephone system in the city or to extensions in the villages.

The costs include steel masts at all locations. In some regions where timber is plentiful, wooden poles could be used for heights up to 60 feet providing a small saving in cost. In other locations locally procured heavy steel pipe could be used for the lower height masts.

The costs do not include transportation or installation costs.

System Modifications

One possible way of reducing telephone cost per village would be to add telephone lines from the two-way radio unit in one village to other nearby villages. This is technically feasible, but it would require considerable equipment to provide for selectively calling the extension lines separately, for off hook keying of the transmitter and the busy functions. This would amount to about half the cost of a regular village station per extension if they were limited to two or three. Because ordering larger quantities of the two-way radios means lowered costs per unit, separate radio-telephone stations for each village are recommended.

A second modification, the multiplexing of radio broadcasts over the radio-telephone system, might be viewed as a cost reduction if part of the radio-telephone costs could be assigned to a separate radio costs category. Special designs would have to be provided, however, for units with more than twice the radio bandpass (300-3000 cps) of standard mobile radio equipment, wide band modulation, and multiplexing equipment for the transmitters and receivers. Although no formal analysis of costs has been made, it appears that, on the quantity basis given above, this might triple the cost of the village units. It is, therefore, recommended that other methods be used for providing village radio broadcast reception (see Chapter III).

D. Two-Way Radio in South Vietnam

A major departure, especially with regard to cost, from the equipment described above are the two-way radios which have been designed by the Office of Public Safety of the Agency for International Development for use in Vietnam and for police and other purposes in other underdeveloped countries. Because of their design features and low cost they deserve careful consideration for more extended use as a means of rural communication.

1. The System

The following is a description of the use of these two-way

radios in South Vietnam. The system of communication used there is more local and is aimed at maintaining contact with smaller groups of people--down to the hamlet--than the other examples which have been discussed.

In 1961 one of the AID personnel in Vietnam found that in order to maintain adequate contact with the villages and for them to provide warning and ask for assistance if attacked, a two-way radio ought to be developed for this purpose. It became apparent that most of the villages were located within 15 to 20 miles of a district office, and, consequently, most of the radio circuits could be considered line-of-sight. This was also true in mountainous locations because the villages reporting to a district office are up the valley from the D.O.'s and a village is very seldom on the opposite side of the mountain.

A total project (generally referred to as the village-hamlet radio) was conceived which was "to support and assist the Government of Vietnam (GVN) to provide, operate and maintain integrated telecommunication facilities and services for the GVN Police and other Civil Security Agencies in direct support of the counter-insurgency effort and for the general preservation of civil law and order."

In order to carry out these objectives the Public Safety Division of AID designed and had manufactured a series of two-way radios called the TR-20, TR-5, and HT-1. The normal effective range of communication for these units is 20-30 miles, 10 miles, and 3-10 miles, respectively.

Further, a system for maintaining national communication through a series of relays was set up. The country is divided into regions, the regions into provinces, and the provinces into districts, which contain villages and hamlets. This equipment was designed for use on the province level and below.

The system is one of connecting provincial capitals with district offices (D.O.), as well as district offices with other D.O.'s in the province, by means of the TR-20 two-way radios. For this communication net each D.O. has one TR-20. For communication with the villages in its vicinity, each D.O. has another TR-20--for a total of two. In each village there are likewise one unit (a TR-5) for communicating with the D.O. and another TR-5 for communicating with nearby hamlets. The hamlets normally have an HT-1, but can have a TR-5 if they are at some distance from the village.

The net may therefore be pictured as follows:

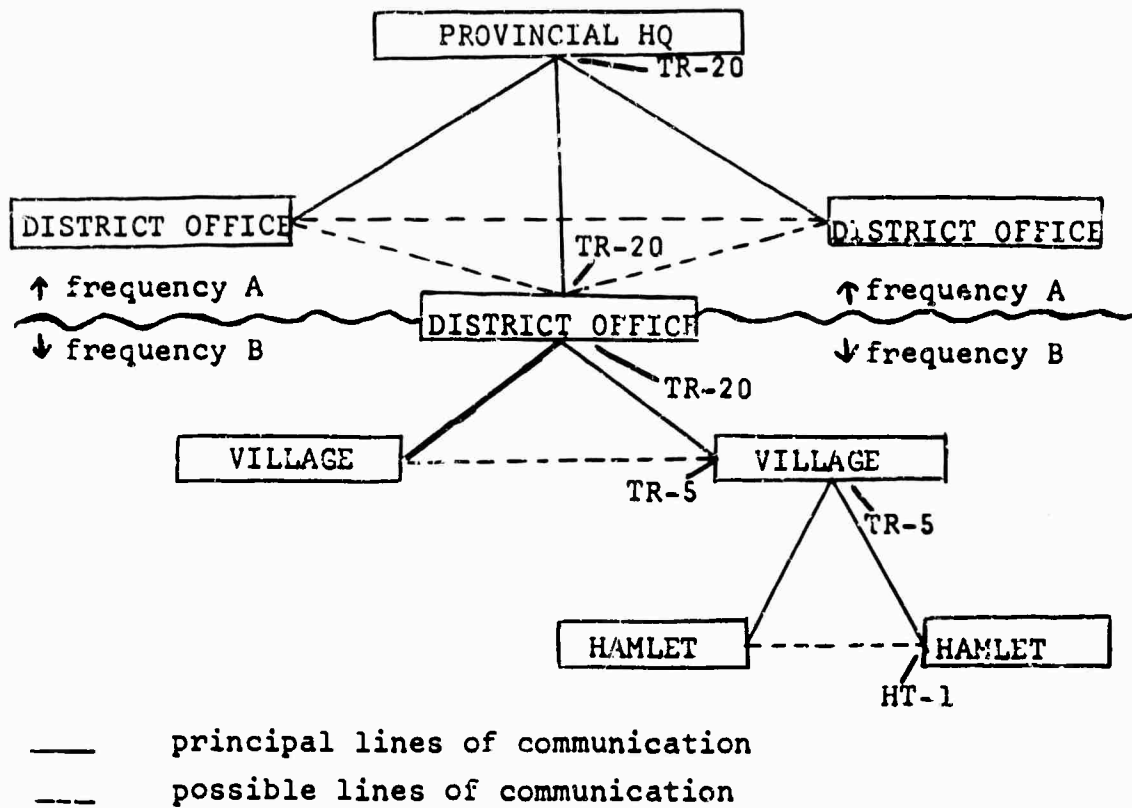


Illustration 9. Village-Hamlet Radio in South Vietnam
(Schematic Diagram)

An essential feature of the system is that each district is assigned a separate and distinguishable frequency on which all the radios in that district operate. In addition, each radio can hear the transmission of every other radio which is within range and can cut into talk. Thus, communication is completely open, and the number of hamlets which communicate with a village or villages with a D.O. is normally determined by the number of sub-units which are in range--which may be up to a dozen or so, although on the average it may be only half that number. Because of the possibilities of such free exchange of talk, strict discipline is maintained, and anyone who cuts in without good reason while someone else is talking is sharply reprimanded. All sets are currently operated by a person who is in some way connected with the Government.

Due to the vulnerability of many of these radios to capture by the Viet Cong, two major precautionary steps have been taken. First of all, each radio has a "destruct" button on it which when pushed sends 300 volts through the circuit and completely burns it out. If a radio is captured (and a recent estimate has put the number of radios captured by the Viet Cong at just under 1000), however, it cannot be certain that the destruct button was pushed or, if it was pushed, that it worked.

A second precaution is therefore taken. Each set works on a single frequency which is pre-set by the crystal which is

installed in it. All radios within a district have the same crystal (frequency), which is why they can communicate with each other. There are 120 possible frequencies, however, which can be used. The country is divided into 5 zones and no frequency is repeated within any one zone. Thus, if one radio in any net is captured, the precaution taken is that all the radios in that net are replaced by new radios at a different frequency, and the old radios are installed in another zone at a distance of perhaps 150 miles away. This makes it extremely difficult for a Viet Cong with a captured radio to find other radios with the same frequency.

As of about June 1965 the following numbers of radios were installed in Vietnam.

Table 24. Village-Hamlet Radio Installations in South Vietnam
(as of about June 1965)

<u>Location</u>	<u>Type</u>			<u>Number</u>
	<u>HT-1</u>	<u>TR-5</u>	<u>TR-20</u>	
1. North Lowlands Region	627	232	320	1,179
2. South Lowlands Region	614	164	270	1,048
3. Highlands Region	462	97	196	755
4. Eastern Region	1,094	312	394	1,800
5. Upper Mekong Region	1,202	375	414	1,991
6. Lower Mekong Region	798	248	297	1,343
7. Saigon Area	364	64	346	774
Totals	5,161	1,492	2,237	8,890

By the end of summer 1965, there were over 10,000 radios installed, and another 1700 radios of a new type (see below) were being shipped specially for use at checkpoints along the road.

2. The Equipment

The three units currently in use are the TR-20, the TR-5 and the HT-1 (Handy Talkie). This equipment was designed specifically for use in the Vietnam setting and therefore meets the highest standards for ruggedness, dependability, simplicity of construction, and ease of operation and maintenance. General specifications for each of the three units are:

TR-20

Frequency range	30-40 Mc
RF Power Output	20 watts
D.C. Current drain	
Transmit	9.7 Amps
Receive with signal	200 M. Amp
Operation	Voice and MCW
Range	Normal 20 miles (30 Km) Extended 30 miles (45 Km)
Power Source	12 V DC or 115 V AC
Weight	20 lbs.
Size	12 1/2" x 11 1/2" x 6"

TR-5

Frequency range	30-40 Mc
RF Power Output	5 watts
D.C. Current drain	
Transmit	3.5 Amps
Receive with signal	120 M. Amp
Operation	Voice
Range	10 miles (15 Km)
Power Source	12 V DC
Weight	10 lbs.
Size	8 1/2" x 5 1/8" x 10 1/2"

HT-1

Frequency range	30-40 Mc
RF Power Output	0.5 watt
D.C. Current drain	
Transmit	140 M. Amp
Receive with signal	70 M. Amp
Operation	Voice
Range	
Hand held	3 miles (5 Km)
External antenna	10 miles (15 Km)
Power Source	
Internal	8 series D dry cells
External	12 V storage battery
Weight	6 lbs.
Size	11 1/4" x 2 3/4" x 2 3/4"

It should be noted that these units were designed for jungle usage--which has a particularly strong attenuating effect. Depending on the terrain, therefore, and using an external antenna, the TR-5 can have a range of 20 miles, the TR-20 a range of 60 miles, and the HT-1 a range of up to 12 miles.

These units, which were manufactured for AID by the Radio Industries Company, a subsidiary of the Hallicrafters Corporation, have the following approximate current costs:

Table 25. Cost and Maximum Range of Village-Hamlet Type Two-Way Radios

	<u>Cost*</u>	<u>Maximum Range**</u>
TR-20	\$ 430	60 miles
TR-5	275	20 miles
HT-1	155	12 miles

*Costs are those for units in quantities of 1000.

**Range partly depends on whether unit works into a fixed station or not.

These radios have been designed for 24 hours per day service with a 4-5% transmit cycle for the HT-1 and a 10% transmit cycle for the TR-20 and the TR-5. On this basis the HT-1 can operate for 2 weeks on 8 dry cell batteries, and the TR-20 can operate for 2 weeks and the TR-5 for 3-4 weeks on a single storage battery. Locally made batteries are available in both Vietnam and Thailand.

Analysis has shown that this equipment can be considered as being amortized over a period of 4 years at a cost of \$90 per year for each TR-20 village radio (\$7.50/month) and \$35 per year for each HT-1 hamlet radio (\$3/month). This is relatively cheap for communications and is generally less than the cost of the telephone in individual homes in the U.S.

The Public Safety Division of AID has recently designed two new units on the basis of the field experience with the TR series. There were two immediate reasons for designing new units now. First, the TR series units have a life expectancy of from 5 to 8 years and because installation of them began in 1962, they will require replacement at an increasing rate during the 1966-70 period. Therefore, this is an auspicious time to make any design modifications.

Second, the TR series is amplitude modulated (AM) because it was designed mainly for rural use--away from the electrical interference found in built-up areas.

For increasing use in motor vehicles and in cities, and to offer a choice of equipment for use in rural or urban areas, the new units are frequency modulated (FM). This new series

includes only two units, designated the FM-1 and the FM-5, to be equivalent to the HT-1 and the TR-5, respectively. Based on the experience over the past 3 1/2 years of operation, it was felt that these units had sufficient capability for most purposes and that a more powerful FM unit equivalent to the TR-20 would not be needed.

The cost of these units, which are being manufactured by the Motorola Company, are (in quantities of 1000):

FM-1	\$195
FM-5	\$325

In small quantities, the FM-1 may cost about \$350. Approximately 1700 of these units are now being shipped to Vietnam.

Both the TR series and the FM series offer performance quality equal to that of U.S. commercial equipment which normally costs at least three times as much as this equipment, and they clearly offer other features which no other equipment now available duplicates. For example, all internal components are mounted on a printed circuit board which is easily removable as a single piece, internal access being gained by removal of one end plate which can be released by turning a single screw with a coin or similar instrument. Numerous other detailed features have been engineered with the most rugged use and the most inexperienced operator in mind.

The FM-1 is a fully transistorized, hand-held VHF-FM (150-172 Mc) radiotelephone; wide band (\pm 15 Kc deviation); one watt RF output into antenna; single frequency crystal-

controlled transmitter and receiver; push-to-talk operation, 12 V DC operation; primary power source, eight series "D" flashlight batteries, with external 12 V DC power receptacle, weighing less than five pounds (including whip antenna and internal batteries); it comes fully equipped with one set of crystals, all integral transistors and speaker/microphone.

The FM-5 is a fully transistorized, portable VHF-FM (150-172 Mc) radiotelephone; wide band (\pm 15 Kc deviation); five watt RF output into antenna; single frequency crystal-controlled transmitter and receiver; push-to-talk operation. Primary power source is a 12-volt DC external battery. Emergency power source is eleven series "D" flashlight batteries. The unit weighs less than 7 lbs., without the emergency battery pack; less than 11.5 lbs. with the emergency battery pack. It is fully equipped with one set of crystals, transistors, power cord and connectors, microphone and speaker.

A power supply has been designed for the FM-5 which provides a regulated 12.5 volts DC. It operates from either a 110 or 220 volt AC, 50 to 60 cps, power source. The power supply is fully solid state, is 10 1/2" x 4 1/4" x 10" and is designed to be as rainproof and as waterproof as possible. Its duty cycle is 100% at ambient temperature of 25 degrees C. and output load of 1.5 Amps and 50% (2 minutes on, 3 minutes off) at ambient temperatures of 40 degrees C. and output of 1.5 Amps. The duty cycle for the FM-5 is continuous. For the FM-1 it is 6 seconds receive at the rated audio power output (150 milliwatts), 6 seconds transmit at the rated RF

power output (1 watt), and 48 seconds in the standby condition.

3. Other Uses

The TR-20 series of two-way radios has so far been used mostly in government communications systems of various types.

Suggested uses for the TR-20 have been:

1. Village-hamlet communications;
2. Short distance radio telegraph (MCW);
3. Police and fire fixed station;
4. Harbor and river patrol;
5. Police and highway patrol--the TR-20 (being AM) can only be installed in vehicles for limited mobile use in rural areas;
6. Construction and conservation projects.

In addition to Vietnam a few hundred of these radios have been installed in Thailand with equally successful results and in one extended African country a relay system for use by the government and security forces has been established which covers 250 miles with this equipment. The possibilities of setting up relay systems, as in this African country, or of establishing local and regional nets of communication, as in Vietnam, are clear, and the cost of using this equipment may well be far less than that of using everyday commercially supplied units.

In most instances so far, for a civilian to use this equipment has meant going to a government and often a police

official. With expanded installation of this type of equipment in rural areas, consideration may have to be given to greater operation and usage by civilians, normally perhaps the headman of a village.

In addition, assuming that one reason for making a telephone available in rural areas is so peasants will use it, then one purpose for civilian control of the instrument in some countries is obvious in Frey's observation that for the Turkish peasants "since ill more often than good comes from the government (historically in the form of taxation, military impressment, bewildering administrative and legal restrictions, and gendarme brutality), it is wisest to take pains to avoid contact with the government if at all possible --to take pains to avoid greater pains. Vestiges of this strategy are to be seen in the very locations of many Turkish villages--placed as inconspicuously and remotely as possible on the landscape to avoid governmental scrutiny."¹

It might be mentioned, however, that an argument can also be made that making telephone usage available in government offices could act as an agent for changing the traditional view of what contact with the government means. Nevertheless, the saliency of this argument toward the use of a telephone located in a police station may well be questioned, and in the more rural areas the existence of any type of permanent government service becomes increasingly rare.

¹F. W. Frey, "The Politicization of the Turkish Peasant: Selected Aspects," Unpublished Manuscript, M.I.T.

Thus, as the number of units being used increases, there may well be a rapid decrease in availability of operators who can make even minor adjustments and repairs. Nevertheless, when problems develop, it may be possible, depending on nearness to a central point and accessibility, to send in either repairmen or new sets by jeep, helicopter, or light plane.

Conclusion

A. Technical Problems in Planning

There are two practical problems which developing countries face in planning for the use of communications equipment.

The first is the very complex matter of deciding what equipment should be bought in what quantities from what companies (and from which countries). Basically, there has been the desire to obtain the highest quality and most modern equipment. For the leaders of developing countries this can be very much of a status symbol, but it also represents the fear that everything they hear about transistorized equipment and earth satellites will make the equipment they buy now obsolete in a few years. More will be said about this below.

The communications experts, however, also emphasize the importance of installing the highest quality equipment available. Their reason is that it affords economy of operation. One example of this concern was expressed as follows:

The close relationship between reliability--that aspect of adequate overall quality which keeps equipment or apparatus units working--and the cost to the telephone companies of keeping a system in operation has been well known for many years. Little short of the ultimate in minimizing failure per operation is tolerable because frequency of failure directly affects system maintenance costs.

Outside of the telephone system, however, customers and suppliers often overlook this relationship and sacrifice reliability for a

lower initial cost. It is not surprising, then, that the annual maintenance cost of these systems has, in certain cases, been as much as double the initial cost of the system.¹

There is little question that much of the communications equipment made available to underdeveloped countries is of the highest quality and of correspondingly high cost--reflecting, in fact, the standards of the developed countries.

These standards, however, represent little concern for making the types of economies in equipment manufacture which might be more appropriate for those countries with limited capital resources. This is particularly true with regard to radio receivers, but also for two-way radios.

Aside from purely technical quality-cost considerations, many underdeveloped countries have had to choose between alternative foreign company--and foreign government--sponsored projects. The costs of these projects, and the terms of the loans offered to cover the costs, have sometimes been determined on political bases.

The second major problem in planning for the use of communications equipment is reflected in the experiences and attitudes of the manufacturers of communications equipment.

Many companies have seen the developing countries' need for appropriate communications equipment and have a more than passing interest in supplying to this conceivably almost

¹Bell Laboratories RECORD, May 1965, p. 163.

inexhaustible market. Attempts to sell to this market over the past few years, however, have led to increasingly cautious attitudes by the manufacturers.

To begin with almost all equipment being sold to these areas must be "specialized" in some sense, which usually means small quantities being ordered and correspondingly higher costs. In addition this requires that someone (normally a governmental or non-professional organization) write a set of specifications for the equipment.

One manufacturer who has attempted to sell radio equipment to Asian and African countries has stated that

this type of equipment is very special rather than universal in nature. The "user's needs" may differ depending on location in the world. Until now, we have only replied with proposals in answer to a request to meet a determined set of specifications on the part of a Government Agency.

To illustrate...

1. We can make radio tuners to cover the broadcast band, broadcast band and shortwave band, shortwave band only, etc. Any combination is possible. The antenna system would not be unique, but would be dictated by the frequency covered.
2. Depending upon the requirements, our inclination would be to transistorize the equipment. However, it would be possible that the customer requirements were such that this would be impractical, and a consideration of tubes and transistors would be better.
3. The using area would have to state power supply requirements.¹

¹A. J. Richards, Manager-Operations, ARVIN INDUSTRIES, INC., Electronic Systems Division, Columbus, Indiana, personal communication, letter, August 31, 1965.

Companies which are awarded an initial contract for a specific type of radio or other communications equipment, often with the idea that further sales will be possible, may find either that the contract is not renewed altogether or that it is awarded to another company--perhaps even a company from another country.

In an apparently typical example, the Arvin company, which was awarded the AID contract for the community radio receiver later went ahead with little success in investing its own resources in trying to sell this particular specially-designed equipment to other developing countries. Although initial interest was always high, no orders resulted.

Another experienced communications expert has commented on the same problem in saying "in the past there has been much talk by various countries about facilities of this nature. But I do not recall any having gone ahead.... By the time they got conditioned to going this far they always wanted to go on to something 'better.' In many cases this led to doing nothing."¹

From customers and orders which one manufacturer has called "so illusory," many companies have pulled back. They cannot afford to write their own specifications and try to go out and sell directly to potential customers, because so far this has not worked. They do not feel either that they have the obligation or the right to try to "sell" the Government on sponsoring projects which would be beneficial to underdeveloped

¹E. A. Laport, Director, Communications Engineering, Radio Corporation of America, Princeton, New Jersey, personal communication, letter, July 29, 1965.

countries--and for which they could supply the equipment.

For these reasons the availability of appropriate communications equipment has been limited, and the costs have remained comparatively high. This may not, however, continue to be the situation. Planners in developing countries have been concerned that communications equipment offered to them may not be the best or may soon become obsolete. While there may still be an overtone of this feeling, it becomes increasingly unrealistic. Keeping an eye on the future, however, some developing countries are already asking for estimates of the cost of using earth satellites for radio, television or telephones.¹ Whether or not the use of earth satellites will eventually solve many of the communications problems of developing countries cannot be determined now.

What is known, however, is that the changes in conventional means of communication due to the introduction of transistors have very clearly levelled off. The transistor itself has been proven in terms of reliability, low power consumption, and reduced size of equipment required. Although micro-miniaturization possibilities increase with space-age research, further improvements in commercially available transistors will probably be comparatively minor and the costs are now fairly steady. Thus the best equipment available now is likely to be the best for some time to come. As this fact is made more widely known, and as information is more widely circulated

¹H. Yankey, U.S. Agency for International Development, Division of Engineering, Office of Capital Development and Finance, personal communication, Washington, D.C., September 3, 1965.

about what specific pieces of equipment are now and will be available for a given cost, it is presumed that doubts may be alleviated about what is offered as compared to what might be available, and increasing orders will then bring lowered costs. There is also the possibility that the demonstrated effectiveness of communications experiments in promoting development is having a cumulative and growing effect on the planners' awareness of the potentialities for the use of this equipment and will therefore dictate a higher priority for its usage in the future.

B. Organization and Training

A modern system of communications depends on a knowledge of the capabilities and the costs of the equipment available. It also depends, as Pool has observed, on "a proper mix" with transportation and organization, and, one might add, training.¹

Probably the best example of the effectiveness in achieving development goals of combining organization and training with mass media usage and village physical accessibility has been UNESCO's Radio Rural Forums (See Chapter III, B).

The success of these forums depends in large measure on the feedback which the program planners at the radio station receive from the village discussion groups and the local staff members such as the village level worker (VLW). The lines of

¹I. Pool, "Communications and Development," in Weiner, M., (ed.), Modernization, Basic Books, Inc., New York, 1966, pp. 98-109.

communication are therefore as shown in the chart on the following page.¹

Because the feedback process requires transporting materials from the radio stations to the villages and back again, one of the requirements for selecting villages to participate in the forums has been that they have "adequate postal and transport facilities."²

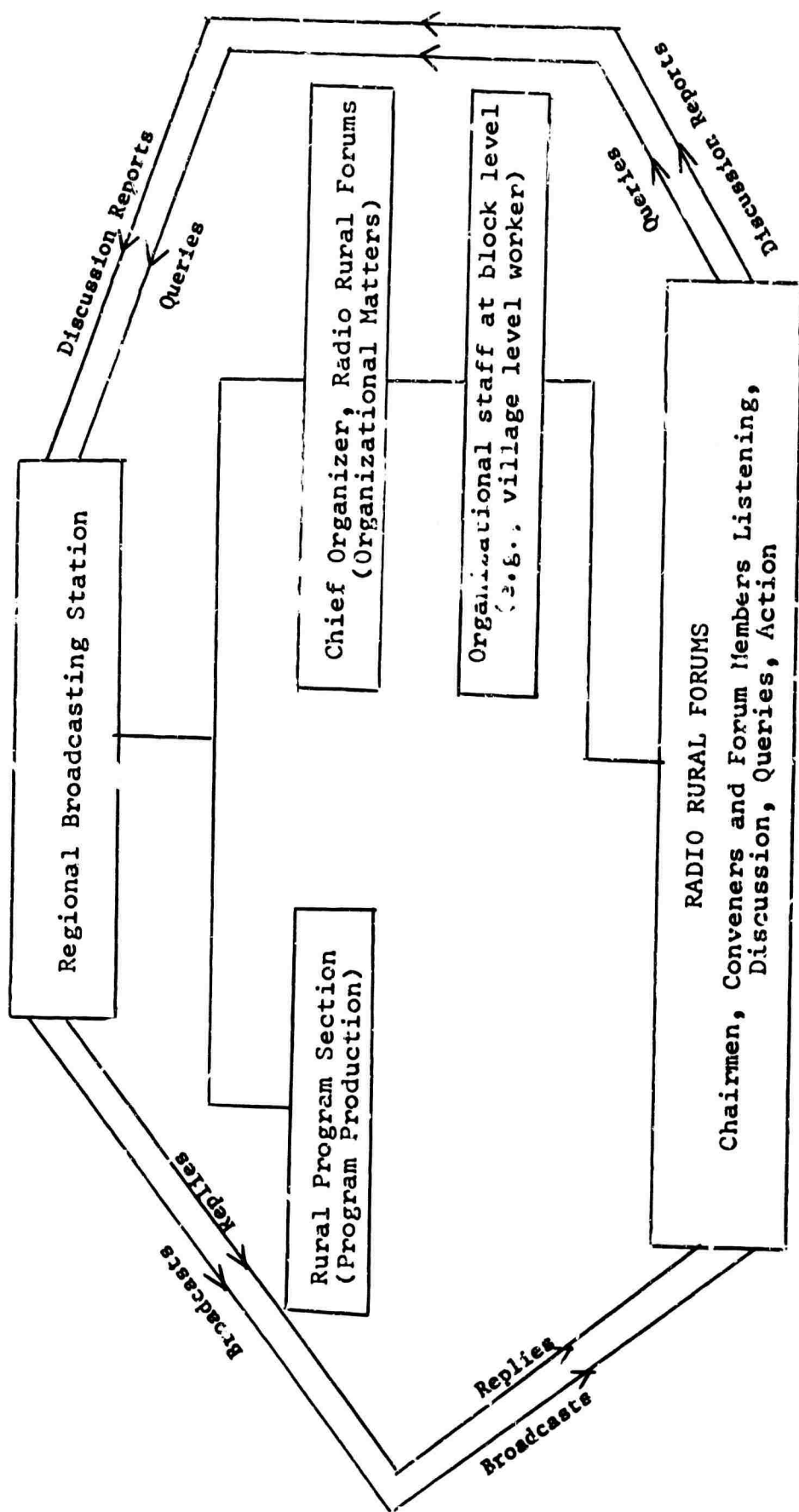
If transporting the reports and other materials is too difficult, there is a lower percentage rate of return and communication breaks down. In the initial Indian experiment, however, where the villages were in essentially urban areas, 71% of a possible 2900 reports were returned. In Togo also over 70% of the reports were received.

As the rural forum programs expand within a given country, however, it can be assumed that adaptations in procedures and organization will have to be made to accommodate the more isolated villages. While the lines of communication to the less accessible villages may remain essentially the same, the means of communication could well be altered. It may be that the dependence on personal visits by city officials and on posted reports by village leaders will have to be decreased. What could take the place of these mechanisms is an increased use of two-way radio for even more frequent (conceivably daily) contact,

¹Chart drawn from "Radio Broadcasting Serves Rural Development," Reports and Papers on Mass Communication, No. 48, UNESCO, Paris, 1965, p. 11.

²Ibid., p. 14.

Illustration 4, The Lines of Communication
Radio Outflow to Rural Forums



although perhaps in somewhat less detail if the length of the conversations needs to be kept to a minimum. While more detailed reports could periodically but after longer intervals be sent from village to radio station, using a two-way radio could also reduce the necessity of having a fairly literate person in the village to make the reports.

The value of this sort of approach has been implicitly recognized in Ghana, where it has already been agreed that the Ministry of Social Welfare should become deeply involved in organizing and servicing Radio Rural Forums in the remote areas where they do have permanent staff located.¹

Because the establishment and operation of these projects requires definite skills, "the training of organizers, from the chief organizers down to the (village) convenors, continues to be an essential prerequisite for the success of radio rural forums."²

In addition to specific training for the forums, more generalized training in radio broadcasting has been required. Therefore, the 1961 UNESCO meeting on Educational Broadcasting in Tropical Africa at Moshi, Tanganyika, recommended that training be provided in "the production and reception of programs serving adult education and community development, particularly in rural areas."³

¹H. C. Abell, op. cit.

²"Radio Broadcasting Serves Rural Development," p. 19.

³"Mass Communication and Agricultural Education," paper prepared by the Department of Mass Communication, UNESCO, for the Meetings on Agricultural Education in Africa and the Middle East, September-October 1963.

Subsequently two training courses were held in Africa for these purposes. One in Uganda in 1962 was for English-speaking participants and the other in 1963 in Mali was for the French-speaking. A description of the training offered is now available.¹

With the expanded use of radios, more people with technical skills are required for servicing equipment. Technical problems in turn require that there be communication and access between those places where the radios are located and those places where the technicians and the spare parts are available. That transport is required in order to facilitate the installation and servicing of communications media points to the initial proposition stated above of the need to find the "proper mix" of communications and transport.

C. Communication and Transport: The Investment Choice

A plan for development is a set of decisions about allocation of scarce resources. It states goals to be sought and means for reaching them. Statements of goals, however, vary from the idealistically vague to the unrealistically specific and from the grandiose to the particular. To be useful they must be translated into more operationally meaningful terms. Knowledge of practical means for reaching development goals is growing, but progress is slow. What means are available, when different means are appropriate, and how much they cost, must all be specified.

¹"Radio Broadcasting Serves Rural Development," pp. 30 ff.

Decisions on goals and means for national development are affected by Communist or non-Communist ideology, by theories of economic planning, by situational conditions, and by methods of analysis. No single investment formula could accommodate all these factors. Nor even could any single development plan be certified as being the best possible for a given country. Rather, for each country a number of investment strategies might be devised which would all give good results. The problem is to identify this group and to pinpoint the optimum alternatives.

When development plans include projects which are large and indivisible, wrong investment decisions are costly and usually irreparable. Building a railroad is a project of this nature in the transport sector. To reduce the possibility of costly mistakes, attention should be given whenever possible to projects for which decisions on when, where and how they are to be carried out need not be made all at once. Transport and communication links appropriate for rural areas, which are essential for national development, fall in this category. Rural roads can be built, extended, upgraded, or allowed to lie untended, as conditions warrant. Because almost all areas of developing countries are covered by radio broadcasts, radios can be installed in the villages where, at the time of installation, it is thought they will contribute most to development. Two-way radios can be designed to connect any two locations. As usage grows, greater capacity equipment can replace the original installation, which in turn can be placed elsewhere. This flexibility can lead to increased investment efficiency.

Even greater flexibility can be achieved by examining the ways in which communication may substitute for transport. Until now, the hypothesis has not been examined that communication media could be as beneficial or more beneficial than transport facilities. This has probably been due, in part, to the lack of substantial evidence comparing the effects of the two. In the early stages of rural development it is presumed that roads are built in order to raise the level of knowledge and culture in the surrounding areas. But if it is found, as in the Turkish data presented here, that this function can be better performed by the mass media--that even travel to and from villages may be increased more by the mass media than by constructing roads--then a new dimension has been added to thinking about the purposes and timing of road-building. Construction of roads, which is more expensive than the installation of communication media, can be postponed until the roads are needed for transport of goods, for regular movement of people to places of economic importance, or for military or police purposes.

Perhaps the major reason why the exploration of the substitution of communication for transport has not been undertaken before has been that the types of communications equipment which could be used had neither been specified nor costed out. Now this has been begun. Wired radio, for example, is almost completely unknown in the United States, yet it was found capable of providing better reception at lower cost than transistor radios. Likewise, the telephone, ubiquitous and constantly

used in the developed countries, has been largely ignored in developing countries. Providing a single two-way radio, however, for regular contact between a village and the nearest trading center or administrative unit could increase communication and provide contact when roads are non-existent or impassable. It has been shown here for the first time how costs for two-way radio can be estimated for various terrains and distances.

Of the communications media available to developing countries, radio and two-way radio are the ones which have been most fully considered in this paper. They can be extensively used at low cost. Other media that deserve further consideration are inexpensive mimeographed newspapers, which have already been published in rural areas with good effect, and television, which is much more expensive but has been suggested for use under certain conditions outside of urban locales.

Many may dismiss television as obviously being too costly for developing countries. Such a decision, however, ought to be made as part of an investment strategy which compares television with other ways of meeting a particular goal. This requires knowing the costs and potential benefits of using various types of television equipment and comparing them with similar information about other suggested ways of meeting the desired goal. This is a further example of the approach to investment decision-making which has been explored here within the transport and communications sector. As this last example implies, it is an approach which can be applied to other critical components of the development syndrome as well.

Appendix. The Contributions of Transport and Communications to Development

An important part of investigating the relationship between transport systems and communications systems is the definition of goals and the evaluation of the ability of each system to contribute to goal achievement. Thus if both systems are independently capable of achieving a given goal, only one of the systems need be provided. Even where substitutability is not evident, the analysis of the contribution of each system toward desired goals provides a framework for better understanding its role in the development process.

The list of goals is meant to be suggestive rather than definitive, though an attempt has been made to select the important goals discussed in the literature of communications and transport development. These goals include changing the attitudes and behavior of the population, political integration, economic development, and better and more widely spread education.

A. Modernization of Images, Attitudes and Behavior

Development literature is paying increasing attention to the importance of modernizing people. Indeed, changes in images, attitudes, values, beliefs, and behavior are often identified as crucial variables in the process of development.¹

¹For reviews of the literature indicating this change in emphasis cf. Hirschman, Albert O., The Strategy of Economic Development, Yale University Press, New Haven, 1961, pp. 1-28; Hagen, Everett E., On the Theory of Social Change, The Dorsey Press, Inc., Homewood, Ill., 1962; McClelland, David C., The Achieving Society, D. Van Nostrand Co., Inc., New York, 1961, pp. 1-19.

It has been asserted that there is a culture of poverty, and that this culture maintains certain views of the world that are inimical to development.¹ The manner in which a person views the world greatly influences individual and collective behavior, personality and culture, and the capacity to develop. This subject has been pursued in the literature of the social sciences under a number of different titles including "unconscious systems of meaning" (Edward Sapir), "core culture" (Laura Thompson), "value orientation" (Klyde Kluckhohn), "basic personality types" (Ralph Linton), "value-orientation patterns" (Talcott Parsons), and "world view" (Robert Redfield).

The process of modernization is, very largely, the process of acquiring new images. For example, there is the image of life as subject to deliberate change. The peasant who perceives the failure of his crops as resulting from the operation of a jealous purposeful fate against which man is impotent can acquire, instead, the image of events as subject to technical manipulation through knowledge and organization.²

Studies indicate that communications media have the capacity to alter images.³ It is less clear to what extent they may alter attitudes and actions. Hilda Himmelweit, in a study of television viewing by English children, found that there was little change in attitudes and actions, but that the image of

¹Cf. Lewis, Oscar, The Children of Sanchez, Vintage Books, New York, 1961, pp. xi-xxxii; Cohen, Jerome, "Social Work and the Culture of Poverty" Social Work, Vol. 9, No. 1, January 1964, pp. 3-11.

²Pool, Ithiel de Sola, "The Role of Communication in the Process of Modernization and Technological Change" in Roselitz, Bert and Moore, Wilbert, Industrialization and Society, UNESCO, 1963, p. 291.

³idem.

the world was altered considerably.¹ Other studies suggest that communications systems can influence actions, but that human communicators or organizers are important supplements to media systems.² For example, studies of mobilizing rural communities indicate that the suggestion of improved agricultural techniques over the radio did not influence the farmer's practices. However, when the radio listening was in groups and followed by discussion, the suggestions made over the radio were much more likely to be realized in action.³

Other authors suggest other means by which communications systems alter personal outlooks and behavior in ways that are strategic for development. McClelland suggests that the media can increase desire for achievement, which he views as the critical variable in the development process.⁴ Lerner has defined empathy and psychic mobility as important parts of the development process, and he asserts that media participation is instrumental in increasing empathy and psychic mobility.⁵

¹Himmelweit, Hil' . et. al., Television and the Child, Oxford University Press, London, 1958.

²Katz, Elihu and Lazarsfeld, Paul, Personal Influence, Free Press, Glencoe, Ill., 1964; for a description of the systematic application of this principal cf. Yu, Frederick, "Communications and Politics in Communist China," in Pye, Lucian W., Communications and Political Development, Princeton University, Princeton, 1963, pp. 259-293.

³The most extensive experiments have been in India. Cf. Mathur, J.C. and Neurath, P., An Indian Experiment in Farm Radio Clubs, UNESCO, Paris, 1959: UNESCO has also published studies on Canada, France, and Japan that support the same conclusions.

⁴McClelland, David, op. cit. and "National Character and Economic Growth in Turkey and Iran" in Pye, op. cit., pp. 152-182.

⁵Lerner, Daniel, The Passing of Traditional Society, Free Press Glencoe, 1958; Lerner, Daniel, "Towards A Communication Theory of Modernization" in Pye, Lucian W., op. cit., pp. 327-351.

Expectations and patterns of authority may also be affected through communications systems. However, these potential achievements stir ambivalent feelings. It is commonly acknowledged that traditional patterns of authority inhibit the modernization process.¹ While it is believed that communications systems can weaken traditional authority, it is not clear that they can substitute alternative patterns of authority.

Rising expectations are considered a necessary prelude to change. A person must desire change before he is apt to work to achieve it. However, while media may raise expectations, they may not alter a person's behavior or the opportunity structure such that the person can achieve change successfully. Rising expectations may be accompanied by rising frustrations.² Thus a careful course must be charted if the people of a nation are to be mobilized such that the result is development rather than personal frustration and political instability. John Lewis notes that "The appetite for material improvement is now such in India--and in most of the other poor countries--that the only government with any chance of adhering to constitutional procedures is one that is determined to achieve radical economic reform and expansion and

¹Cf. Hagen, op. cit.

²Lerner; op. cit. (1963); Lerner, Daniel, "Suggested Researches for a Sociological Classic on Guayana" (memorandum to Joint Center of Urban Studies of M.I.T. and Harvard University) Caracas, May 21, 1962.

that is capable of so doing."¹ However, a nation committed to rapid development has no alternative to loosening traditional bonds of authority and raising expectations.

The literature of transport is not so detailed in treating topics as changing images, actions, patterns of authority, empathy, achievement motivation, psychic mobility, or expectations. However, there are studies of once isolated villages that were connected to cities by good roads which indicate that transportation developments afford similar potentials for change. Tepotzlan, Mexico developed largely as a result of a new road.² In the Turkish village of Balgat a new road stimulated numerous changes. The village in 1950 was described as barren, traditional, and poor. Just four years later it had acquired electricity, relative prosperity, new stores, a bus station, a school, a police station, and many new and improved houses. For a fare of four cents, the villagers who were formerly farmers were now commuting to work in the factories of Ankara and receiving much higher income. Villagers who four years earlier were traditional in outlook and behavior had undergone dramatic changes. Traditional patterns of authority were replaced; empathy, psychic mobility, and expectations increased; and developed achievement motivation

¹ Lewis, John, Quiet Crises in India, The Brookings Institution, Washington, D.C., 1962, p. 10.

² Redfield, Robert, Tepotzlan--A Mexican Village, University of Chicago Press, Chicago, 1930; Lewis, Oscar, Life in a Mexican Village-Tepotzlan Restudied, University of Illinois Press, Urbana, 1951.

was paralleled by actual achievements. While this study is a moving testimony to the changes that improved transportation can make, it still leaves some questions unanswered. Was it improved transport or improved access to opportunity that created these changes? Would road improvements produce similar changes in remote areas? Conversely, could these changes have resulted in Balgat without the road improvements and bus service? Certainly there is much that is not known about the effects of transport and communication upon modernizing images, attitudes, and behavior.

B. Political Integration, National Development and Internal Security

Since the end of World War II over 50 independent states have been added to the world community.¹ About two-thirds of these nations are underdeveloped countries that evolved as a result of an upsurge in nationalism and a disintegration of the colonial system. Many of these countries believed that all that was necessary was to proclaim national independence. Nasser wrote, for example:

Before July 23rd I had imagined that the whole nation was ready and prepared, waiting for nothing but a vanguard to lead the charge....I thought this role would never take more than a few hours....but how different is the reality from the dream! The masses that came were disunited, divided groups of stragglers...."²

¹U.S. Department of State, Profiles of Newly Independent States, U.S. Government Printing Office, Washington, D.C., 1963.

²Nassar, Gamal Abdul, Egypt's Liberation, Public Affairs Press, Washington, D.C., 1955, pp. 244 f.

After many disillusion in attempting to maintain stable governments, there is an increasing acceptance of the difficult task of nation-building that lies ahead.¹ Claims have been put forward that both transport and communication systems can aid in nation-building. The scope of such claims will be explored from the point of view of creating a national identity, building a national purpose, forming a national consensus, and maintaining the integrity of the national boundaries.

A characteristic of traditional societies is that they are composed of large numbers of relatively isolated groups who identify with such relatively small units as family, tribe, or village. For example, a recent study in Brazil indicated that over one-half of the rural adults could name neither the outgoing nor the newly elected president.² About 95% could not identify either Eisenhower or Castro. Another study in India measured the diffusion of modern information through villages as a function of their distances from a metropolis.³ In Patan, 72 miles from Poona, an important city, the people of the village knew of independence, but not of the partition of India. Only the headman knew of Jawaharlal Nehru, or that he was Prime Minister of India. He knew no more about national politics, nothing about world politics, and nothing about international policies

¹Deutsch, Karl W. and Foltz, William J. (eds.), Nation-Building, Atherton Press, New York, 1963; Silvert and Bonilla, "The Process of National Development" (mimeographed), n.d.

²Free, L.A., Some Implications of the Political Psychology of Brazilians, Institute for International Social Research, Princeton, N.J., 1961.

³Damle, Y.B., "Communication of Modern Ideas and Knowledge in Indian Villages," Public Opinion Quarterly, Vol. XX, No. 1, Spring, 1956, pp. 257-270.

or events. There was no awareness of modern ideas of caste and religion in the village.

It is a monumental task to expand the horizons from such small groups to the nation. The communications systems can aid in this task by exposing people to a wider range of images, ideas and people. Indeed, it has been argued that it is impossible to create a national identity without a national communications network.¹

Not only is it necessary to create a sense of national identity within the population, but it is necessary that there be some consensus regarding this national identity.² The communications system can aid in achieving consensus by disseminating the same information throughout the nation.³ The exploitation of the relationship between communications and power is also an important aspect of consensus building. This is widely recognized by dictatorial and communist governments which show great concern for the control of communications. This is also apparent within any country during times of war or national

¹Deutsch, Karl W., Nationalism and Social Communication, John Wiley & Sons, Inc., New York, 1953.

²The importance of national political conflict and consensus is well illustrated in the analysis by Jorge Ahumada, "Hypothesis for the Diagnosis of a Situation of Social Change: the Case of Venezuela" (mimeographed) n.d.; also cf. Ashford, Douglas, "Patterns of Consensus in Developing Countries", American Behavioral Scientist, Vol. IV, April 1961, pp. 7-10.

³The limits of media to change opinion and provide consensus are suggested by Noelle-Neumann, Elisabeth, "Mass Communication Media and Public Opinion," Journalism Quarterly, Vol. 36, Fall, 1959, p. 401; Simon, Herbert and Stern, Frederick, "The Effects of Television Upon Voting Behavior in Iowa in the 1952 Presidential Election," American Political Science Review, Vol. 49, June 1955, pp. 470-477; Pye, Lucian, op. cit., pp. 124-127.

emergency. "Communications patterns generally seem to act as a limiting factor for power configurations....there is no power relationship without some direct or indirect communications linkage."¹ A third function of communications is to bring diverse groups into contact with each other. While it is not clear under what conditions communication may increase conflict, it is clear that increased communication is a pre-requisite to consensus among diverse groups. This is important as, in traditional societies, "There is little or no integration among the participants due to lack of a unified communications system."² "...from a communications point of view it is possible to relate the problems of the development of the mass media, the organization of political articulation and the expression of interests, and the formation of collective opinions with the individual's reactions to the challenge of new ideas, his groping with conflicting values, and his search for new perspectives--and to demonstrate that all these complex problems underlie the general problem of political consensus."³

Communications systems can also help to infuse and diffuse a sense of national purpose. They can assist in mobilizing the population through clarifying the goals to be achieved and

¹Frey, Frederick, "Political Development, Power, and Communications in Turkey" in Pye, op. cit., pp. 303ff.

²Pye, Lucian, Politics, Personality, and Nation Building, Yale University Press, New Haven, 1962, p. 20; also cf. Almond, Gabriel and Coleman, James, et. al., The Politics of the Developing Areas, Princeton, University Press, Princeton, N.J., 1960; Breed, Warren, "Mass Communication and Socio-Cultural Integration," Social Forces, Vol. 37, December 1958, pp. 109-116, Deutsch, op. cit.

³Pye, op. cit. (1963), p. 11.

the steps necessary to achieve them. This can be aided by the multiplier effects of media upon charismatic leadership, state propaganda, or the directives of a national plan.¹ Also important is the communication from the masses to the political leaders and the national planners which can assist in the development and articulation of realistic objectives such that the sense of national purpose will not be a fleeting victory undermined by frustrations in achieving the stated objectives.²

Finally the stability of a political system depends upon its ability to maintain the national boundaries. In many underdeveloped societies the boundaries are in remote areas. Little information is available about what is occurring in the region of the boundaries and consequently it is impossible to control them. In the extreme case of armed conflict, military effectiveness is limited by the communications functions of intelligence and command. Mention has been made here of the communications now used in Vietnam. The more subtle attacks of sub-

¹On charismatic leadership cf. Weber, Max, "The Sociology of Charismatic Authority," From Max Weber: Essays in Sociology, Oxford University Press, New York, 1956, pp. 245-253; Shils, Edward, "Demagogues and Cadres in the Political Development of the New States," Pye, op. cit., pp. 64-78; on state propaganda cf. Inkeles, Alex, Public Opinion in Soviet Russia, Harvard University Press, Cambridge, 1953; Yu, op. cit.; on the national plan cf. Schramm, Wilbur, "Communications Development and the Development Process," in Pye, op. cit. (1963), p. 39; Freidmann, John, "Creating a Development Society," The Uses of Planning (mimeographed) n.d., pp. 12ff.

²Cf. Ahumada, op. cit.; Shils, op. cit.; Deutsch, Karl, "Communications Models and the Political Decision System," The Nerves of Government, Free Press, Glencoe, 1963, pp. 145-257.

version and guerrilla warfare also require a widespread communications network for intelligence and command.

Literature on the relationship between transport and national identity and transport and consensus building is virtually non-existent.¹ This is probably due to the orientation of transport planners and also to the importance of intervening variables in these relationships. One might suspect that transport planning would be most effective in achieving these goals at the regional scale by linking urban and rural areas. As urban areas usually manifest a greater sense of national identity, such linkages might help diffuse the sense of nationhood to rural areas.² Improved accessibility in rural areas might also result in more frequent contact between villagers and such representatives of the national government as community development workers, doctors, tax collectors, mailmen, or militia. Such contact might widen the horizons of the villagers.

Transport could work in essentially the same way as communications in developing consensus through easier contacts between diverse groups. However, there is no clear evidence that such contact would necessarily produce consensus. In fact, there is some evidence to the contrary indicating that

¹Cf. Innis, H.A., Empire and Communications, Oxford University Press, London, 1950; Wolfe, Roy, Transportation and Politics, D. Van Nostrand Co., Inc., Princeton, N.J., 1963.

²There are many discussions of diffusion from urban areas: cf., for example, Lerner, Daniel et. al., "Static and Dynamic France" (mimeographed) Center for International Studies, M.I.T., 1964: Urbanites are also leaders of revolutions and often feel alienated from their countries. Cf. Almond, Gabriel and Verba, Sidney, The Civic Culture, Little, Brown and Co., Boston, 1965, pp. 63-68.

increased contact between diverse groups may increase intergroup conflict.¹

Transport improvements can help to build a sense of national purpose through a demonstration effect. Thus monumental avenues are often constructed in important cities. The building of a road for a village may also be an important symbolic act. It may alter the attitudes of the villagers and encourage them to associate their interests with the national government. Villagers have a traditional distrust of government which in reality is probably justified in that the tax collector and the policeman have usually symbolized the government.² The transport system may benefit national purpose indirectly by its impact on economic development, education, and health, which may change the attitudes of the populace toward the government. An indication of this interaction is Frey's finding that in Turkey sex and literacy have important effects on the use of transport and communications systems.³

An adequate transport system is also an important factor in maintaining the political boundaries.⁴ Troop mobility is an important aspect of any defense effort. For example, a significant response to the border conflicts between China and

¹A detailed review of the literature is available in the International Sociological Association's The Nature of Conflict, UNESCO, Paris, 1957.

²Cf. for example, Banfield, Edward C., The Moral Basis of a Backward Society, Free Press, Glencoe, 1958; Lewis, Oscar, op. cit.

³Cf. Frey, Frederick, "Five Nations Plus One" (mimeographed), Paper delivered at the Annual Convention of the American Association for Public Opinion Research, 1964, p. 8.

⁴Cf. Harbeson, Robert, "Transportation: Achilles Heel of National Security," Political Science Quarterly, Vol. 74, 1959, pp. 1-20.

India in Ladakh has been road development.

C. Economic Integration and Development

The literature of transport and communication suggests numerous ways in which these fields can contribute to economic growth. Reference has already been made to the importance of individual images, attitudes, and behavior upon economic development and the part that transport and communication can contribute to modernizing these. The following section will define the contribution they can make to education, another important factor in economic development.¹ Communications also contributes to economic development through improving the efficiency and extending the area of markets, increasing rationality in labor movements, and stimulating innovations.

One of the major inhibitors to economic activity is the high degree of uncertainty in economic decision-making. A poor communications network may result in wildly fluctuating prices. Not only does this produce inefficiencies in existing markets, but it frustrates rational decision-making for the development of new economic activity. "...the inadequacy of statistical information is one of the major causes of uncertainty....Deficiencies in industrial information tend to reduce the effectiveness of the government's own investment

¹Cf. Harbison, Frederick and Myers, Charles, Education, Manpower, and Economic Growth, McGraw Hill, New York, 1964; "Investment in Human Beings" supplement to the Journal of Political Economy, Vol. 70, No. 5, part 2, October 1962.

programme as well as to handicap the would-be industrialist, narrowing his economic horizon and enlarging the risk premium required to attract capital."¹ The result is often that new activities are not undertaken because of the associated high risks resulting from inadequate information. Another result of the weak communications network is a lack of information regarding prices. This results not only in poor entrepreneurial decisions, but provides an environment in which "middle-men" can exploit both buyers and sellers.² Poor price information often means that the middle men may receive the profits from increased food production and the peasants thus have little incentive to produce more.

Communications networks can also be used to extend markets and to help integrate regional, national, and international markets. It is obvious, though rarely stated, that trade requires communication. Two different types of trade should be distinguished, as their importance to development is quite different: that resulting from interindustry (intermediate) demand, and that resulting from consumer (final) demand. In the first, economic development requires increasing inter-industry flows of goods and information, and consequently requires an adequate communications system to support such inter-

¹Processes and Problems of Industrialization in Under-Developed Countries, United Nations, New York, 1955, p. 24; a contrary position is taken by F. Martin, "The Information Effect of Economic Planning", Canadian Journal of Economic and Political Science Vol. 30, August 1964.

²On uncertainty in rural markets cf. Neale, Alter et al., "Kurali Market", Economic Development and Cultural Change, Vol. 13, No. 2, January 1965, pp. 129-169.

industry transactions.¹ In the second case, communications plays a primary role through the use of advertising to expand consumer demand. An important limit to economic development is the size of markets, and consequently the expansion of markets could facilitate development. "...anything that can be done to extend and enlarge the local market contributes directly or indirectly to industrialization."²

Communications can also aid economic development through providing adequate information to guide movements of the labor force. Levels of productivity are distributed unevenly within countries both as the result of rural-urban differences and regional differences. Improved communications systems could improve the rationality in labor movements and encourage the flow from less productive areas to more productive areas, thereby accelerating economic development. This argument would not hold in densely populated countries with high urban and rural unemployment and disguised unemployment. It would be relevant for less densely settled countries and those with areas with labor shortages.

Influencing the images, attitudes, and behavior of people can alter their propensity to innovate and to accept innova-

¹Such structural changes in economic development are noted by Wassily Leontief, "The Structure of Development", Technology and Economic Development, Alfred A. Knopf, New York, 1963, pp. 105-125.

²Processes and Problems, op. cit., p. 14; Drucker, Peter, "Marketing and Economic Development", Journal of Marketing, Vol. 22, No. 3, January 1958, pp. 252-259.

tions.¹ Through supporting research and development activities a country can attempt to systematize innovations. Such attempts require elaborate communications systems.² Furthermore, it is important not only that innovations be discovered, but that they be recognized and diffused.³ Innovations must be communicated to others to be of any value to the development of a nation.

Transport developments aid economic development in a number of different ways. Their impact on individual images, attitudes, and behavior has previously been discussed, and their contribution to education will be elaborated in a following section. Transport also assists economic development through increasing labor mobility, diffusing innovation, extending and integrating markets, permitting area specialization, and altering land use or the spatial distribution of economic activity.

Transport assists labor mobility in two related ways: it allows the location of labor to adjust to production demands and it reduces the cost of movement for labor. If labor is to relocate, it is clear that it must not only possess information that will guide its movement, but it must also have available

¹Anderson, Harold (ed.), Creativity and Its Cultivation, Harper and Brothers, New York, 1959.

²"Scientific and Technological Policy, Planning, and Organization", Science, Technology, and Development, Vol. IX, United States Papers Prepared for the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, U.S. Government Printing Office, Washington, D.C., 1963.

³Barnett, H.G., Innovation: The Basis of Cultural Change, McGraw Hill Book Co., New York 1953; Mead, Margaret, "Creativity in Cross-cultural Perspective" in Anderson, op.cit., pp.222-236.

the means by which to make the journey, although walking is far from unheard of. The decision to move will be in part a function of the possibility of movement and the costs of moving. Costs are also important in the daily journey to work. In low income families a significant part of their earnings may be diverted to transport expenses and away from more productive or socially useful investments. An extreme example is provided in Korangi, Pakistan where average transport expenses account for 20% of household income. For the average family of 5 with an average monthly income of rs. 100 (\$20) this is indeed a burden.¹

Transport improvement contributes to the diffusion of innovation. In the most conspicuous case, it facilitates the movement of the innovators--students studying abroad, technical assistance personnel, or agricultural extension workers, doctors, teachers, and others--from the centers of learning and administration to other parts of the country. In a more subtle manner, facilitating the movement between urban and rural areas encourages diffusion of ideas, artifacts, and behavior patterns.

Transport improvements also permit the extension and integration of economic activity. Often the transport system is not capable of supplying industry with needed materials, or it provides them irregularly or with long delays. For example, "In

¹Central Statistics Office Report on Socio-Economic Survey of Korangi, Government of Pakistan Press, Karachi, 1951, pp.3,29, 31.

1955-1956....India's transportation system....was seriously overloaded; there were long delays and difficulties in moving the raw materials and finished goods produced as industry and the whole economy became more active. In the Second Plan, unless transportation is quickly expanded, lack of adequate transport may be a bottleneck in the country's entire economic development."¹ Often it is inadequate to bring agricultural products to market. Famine in one place may be accompanied by agricultural surpluses in another. At other times, the costs of movement are sufficiently high to place great burdens upon the economy. For instance, much primitive transport is by animal. Yet the cost by animal ranges between 40 and 50 cents per ton mile while mechanization can reduce these costs to 5 cents or less. In Bolivia, until recently the price of domestic rice was 50% higher than imported rice because of the costs of transport. A new highway has now eliminated costly imports through reducing the cost of domestic rice.² Clearly any improvements in transport which would better link the supply and demand for materials and people would facilitate the extension and integration of economic activity.

Transport, by better integrating economic activity, would also allow area specialization. By extending markets and freeing an area from the needs of self-sufficiency, better

¹Planning Commission, Government of India, The New India, The Macmillan Co., New York, 1958, p. 303.

²Cf. Owens, Wilfred, Strategy for Mobility, The Brookings Institution, Washington, D.C., 1964, pp. 7ff.

transport would allow each area to specialize in optimally productive activities based on factors of production related to land, labor, and capital, or simple economies of scale.¹ The nation gains from such specialization through lower production costs, and the region and possibly the nation gain from the multiplier effect resulting from the export sector of the local economy.²

Economic development can be furthered by the interrelationship between transport and land use in several ways. The location of transport influences the spatial distribution of development. The most conspicuous is when transport routes open new regions for development. A classic case is railroad development in the United States. Recent attention has often focused upon highways.³ The transportation system can also favor a concentrated or a decentralized pattern of national, regional, or urban development.⁴ The spatial distribution of economic development is a matter of considerable importance,

¹Cf. Ullman, Edward, "The Role of Transportation and the Bases for Interaction" in Thomas, William (ed.), Man's Role in Changing the Face of the Earth, University of Chicago Press, Chicago, 1956, pp. 862-881.

²For discussions of the multiplier effect, cf. Tiebout, Charles, The Community Economic Base Study, Committee for Economic Development, New York, 1952; Tiebout, Charles, "Exports and Regional Economic Growth" reprinted in Friedmann, John and Alonso, William (eds.), Regional Development and Planning, The M.I.T. Press, Cambridge, 1964, pp. 256-266; Samuelson, Paul, Economics, McGraw-Hill Book Co., Inc., New York, 1951, pp. 676ff.

³Cf., for example, Garrison, William et. al., Studies of Highway Development and Geographic Change, University of Washington Press, Seattle, 1959.

⁴Cf. Meyerson, Martin, "Planning for Movement in Developing Countries", Regional Planning, United Nations (Housing, Building, and Planning Nos. 12 and 13), New York, 1959, pp. 86ff.

and has been a matter of continuing debate among planners. For example, Rodwin has argued for concentrating investment and Wurster has argued for decentralized investment.¹

D. Education

Well over half of the population of developing countries is illiterate. Less than half of the children of primary school age are in school. Curle points out that "in half of the underdeveloped territories the school enrollment of children between the ages of 5 and 14 is only 30 per cent or less....(in some it is) less than 10 per cent."² Of those in school, many are taught by teachers who themselves are untrained. In Nigeria, for example, where the education system is better than in many of the developing countries, over 70% of the 93,000 teachers in primary, secondary, and teacher training schools are untrained.³ The costs of improving education to modern levels in these countries could represent an investment level impossible to achieve. For example, Grennough has estimated that to achieve universal primary education in Ethiopia would require three times the

¹Rodwin, Lloyd, "Metropolitan Policy for Developing Areas", Daedalus, Vol. 90, No. 1, Winter, 1961, pp. 132-147; Wurster, Catherine Bauer, "Urban Living Conditions, Overhead Costs, and the Development Pattern" in Turner, Roy (ed.), India's Urban Future, University of California Press, Berkeley, 1961, pp. 277-299.

²A. Curle, Educational Strategy for Developing Societies, Tavistock Publications, London, 1963, p. 82.

³Schramm, Wilbur and Winfield, Gerald, "New Uses of Mass Communication or the Promotion of Economic and Social Development", Science, Technology, and Development, Vol. XII, United States Papers Prepared for the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, U.S. Government Printing Office, Washington, D.C., 1963.

present total national budget.¹ The need for innovation in education is pressing. Any effort that could reduce costs or serve as teacher multipliers would be welcome. Vaizy estimates that "to staff Indian schools, for example, over one million teachers would be needed if anything like a basic elementary education were to be given to all Indian children."² Communications and transport specialists claim that they can contribute to these educational demands.

The educational system has long utilized teacher multipliers. For several hundred years books have served this function, and more recently, so have radio and television. The use of these media satisfy several related needs including the multiplication of educational "communicators," better utilization of good teachers, and upgrading of untrained teachers. The effectiveness of the media as instruments of education has been subject to a number of tests. The success of rural radio forums has already been noted.³ In Chile a radio school system is operating in 1,300 rural schools, reaching 100,000 children. In Columbia, Egypt, Jordan, and other countries radio is furnishing instruction in agriculture, public health, and other subjects.⁴ Educational television has been successfully tried in several

¹ Africa Calls, UNESCO, Paris, 1961.

² J. Vaizy, The Economics of Education, The Free Press of Glencoe, Inc., New York, 1962, p. 128.

³ Reported in UNESCO studies in Canada, India, France, and Japan, op.cit., and here in Chapter III for Togo and Ghana.

⁴ Owen, op. cit., 1964, p. 78; Schramm, op. cit., p. 16.

countries including Italy, Turkey, Iran, and India.¹ Educational television has been compared to conventional classroom teaching in the United States, and the T.V. results were favorable. In 65% of the 400 comparisons there was no significant difference, in 14% conventional classroom methods were better, and in 21% the television class learned more.² These tests do not indicate that television is an adequate or complete substitute for teachers. The best results have always been when television and teachers have worked together. However, the television broadcast can select and utilize the best trained teachers for broadcasting. At the same time, the classroom teacher is learning by watching expert teaching methods while also being exposed to the subject matter. The centralization of course material permitted by the use of mass media has the further advantage of allowing greater flexibility in permitting more rapid curriculum changes. Such flexibility is a particular asset in the underdeveloped countries where most education is either experimental or inappropriately borrowed from Western models.

Communications systems also perform educational functions

¹Cassirer reviews educational television in 7 advanced countries. Television Teaching Today, UNESCO, Paris, 1960; also cf. Louis R. and Rovin, J., Television and Teleclubs in Rural Communities, UNESCO, Paris, 1955; Dumazedier, J., Television and Rural Adult Education, UNESCO, Paris, 1956.

²Schramm, Wilbur, "What We Know About Learning from Instructional Television", Educational Television: The Next Ten Years, Institute for Communication Research, Stanford, 1962, pp.52-76.

informally. To the isolated villager, almost any contact with the "outside" is beneficial. The educational functions with regard to altering images, attitudes, and behavior, facilitating political integration, and permitting greater rationality in economic decision-making have already been noted.

Schramm has emphasized the importance of this in writing that

Whereas the problems of education and information tend to be separated in an advanced country, in a developing nation they are connected. The mass media must carry the main burden of informing and teaching the public for a long time before an adequate school system can do its part. The planning for mass media therefore gears into the planning for schools and technical training. In a developing country the use of mass media as teacher multipliers assumes an importance it does not have in an advanced nation. Thus the economic strategy of communication development in a developing nation is not separable into a strategy for education and a strategy for information; it must be one strategy.¹

Transport systems contribute to education by increasing the mobility of both the teachers and the learners. In the United States, for example, the traditional symbol of education was the one-room school house. Improvements in transport have permitted the consolidation of school facilities with resulting economies of scale and opportunities for differentiation by age groups and educational needs. In countries with a small percentage of the population in school, it seems probable that easier

¹ Schramm, "Communication Development and the Development of Education," in J. H. Pye, Communications and Political Development, Princeton University Press, Princeton, 1963, pp. 48-49.

access to schools will lead to wider utilization of the facilities.

Owen has taken the position, however, that (in the United States) "the consolidated school with adequate teaching staff and physical plant was made possible only after an extensive road-building program that permitted the transportation of pupils in buses. Today, construction of schools alone will require a great deal of equipment and material....Radio and television may reduce these costs substantially."¹

Nevertheless, combining improved transport systems with mass media availability has led to some interesting innovations. For example, several countries are utilizing mobile audiovisual vans that carry their own power generators. The Philippines, for instance, now operates 22 such units. These units commonly attract audiences of 500 to 3000 people and go to a different community each year.² These vans combine the use of audiovisual aids with trained discussion leaders. Improved transport would also facilitate the movements of such technical assistance personnel as public health workers, agricultural extension workers, community development experts, and a multitude of other specialists who are all involved in assistance and education programs.

Better transport may confer even greater benefits by facilitating the movement of villagers and urban dwellers. Little information has heretofore been available on this. Recent studies in the United States indicate that poor urban

¹Owen, op. cit., p. 78.

²Schramm, op. cit., p. 16.

dwellers are highly immobile. They often are familiar with only a few city blocks and fear the rest of the city as an unfamiliar environment.¹ The experiencing of new and different environments may be of important educational value. Frey found that in Turkey "the peasant appears to need tangible evidence of previously unexperienced and strange phenomena introduced to him from outside his environment--to need to see and touch--before he believes. Moreover, the ideas emanating from....(media) are always very strongly filtered through a cognitive screen manufactured from his own limited experience."² The importance of extending the range of environmental experiences has been recently demonstrated by the New York City "Higher Horizons" educational experiment.³ While this is a multi-faceted program, an important part has been to take the children on field trips around the city, to extend their range of experiences.⁴ A complementary part has been to bring people from "outside" to talk with them in the schools. The resulting changes were remarkable. Those seeking higher education increased 250%. Students had previously dropped IQ points as their education progressed. In contrast, those in the "Higher Horizon" program in 3 years achieved an average individual gain of 13 IQ points, and more

¹Schoor, Alvin, Slums and Social Insecurity, U.S. Government Printing Office, Washington, D.C., 1963, pp. 41f.

²Frey, op. cit., (1963), p. 321.

³Landers, Jacob, "The Higher Horizons Program in New York City", Programs for the Educationally Disadvantaged, U.S. Government Printing Office, Washington, D.C., 1963, pp. 45-57.

⁴The Japanese have a program by which all children in the nation make two trips, as part of their schooling, to other parts of the country. The educational benefits of travel experience are combined with a sense of national identification.

than 25% gained more than 21 IQ points.¹ Exposure to the wider environment contributed a significant part to these educational advances. "It would be difficult to overestimate the value of these trips....It has indeed resulted in 'higher horizons' not only for children, but for the community as well."²

Parallel work has been done on the results of the lack of a variety of environmental stimuli upon the learning capacity and motivation of individuals. "A child from any circumstance who has been deprived of a substantial portion of the variety of stimuli which he is maturationally capable of responding to is likely to be deficient in the equipment required for learning."³ Descriptions of slums where recent work has been done bear striking similarity to most areas within the lesser developed countries. "Visually, the urban slum and its overcrowded apartments offer the child a minimal range of stimuli. There are usually few if any pictures on the wall, and the objects in the household, be they toys, furniture, or utensils, tend to be sparse, repetitious, and lacking in form and color variations."⁴

¹Prepared statement of Daniel Schreiber before the Senate Subcommittee on Unemployment and Manpower, Committee on Labor and Public Welfare, United States Senate, Nation's Manpower Revolution, U.S. Government Printing Office, Washington, D.C., 1963, Part 6, p. 2026.

²Landers, op. cit., p. 51.

³Deutsch, Martin, "The Disadvantaged Child and the Learning Process", in Riessman, Frank et. al., (eds.), Mental Health of the Poor, Free Press, Glencoe, 1964, p. 177.

⁴Deutsch, Martin, op. cit., p. 178; also cf. Hur, J., Intelligence and Experience, Ronald Press, New York, 1961.

If the implications of these explorations in the learning process are valid in underdeveloped countries, the cost of inaccessibility to education may be much higher than previously believed.

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13. ABSTRACT Comparison is made of the uses of investment in transport and in communications for developing countries. A method for investment decision-making is proposed, and relevant data are presented and analyzed. It is hypothesized that in achieving development goals transport and communi- cations may be substitutable or at least complementary. National investment strategies are seen to depend on Communist or non- Communist ideology, on theories of economic planning, on situational conditions, and on methods of analysis. The construction of rural roads is posited as the major transport investment for developing countries in the future. It is suggested that increased rationality in decision-making in the transport and communications sector is possible through the application of cost-benefit analysis at the village level. This is seen to require the collection of cost and descriptive data for a range of communications media and for various types of roads, as well as increased knowledge of the benefits they afford. A model is proposed for the staging of investment. A comparison of some benefits of transport and communications is made through an analysis of data from a 1962 national sample survey of Turkish villages. The			

results give strong support to the presumption that the relation between the presence of the mass media and of modern attitudes is one of cause and effect.

The use and cost of radio in developing countries is examined. UNESCO-sponsored experiments in Asia and Africa are reported. Data from South Korea show that wired radio systems are less expensive, provide better reception, and possibly offer a greater range of program choices than do transistor radios. Costs for components of wired radio systems are provided.

The use and cost of telephone in developing countries is examined. In rural areas two-way radio is less expensive to install and maintain than is telephone wire. Examples of two-way radio systems and equipment are described. Generalized specifications and costs for city-village two-way radio are provided.

The problems of providing appropriate communications equipment at low cost and the need for training and organizing personnel are discussed.

An analysis, based on the literature extant, is presented of the possible contributions of transport and communications to development.

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	Communication(s) Transport Transportation Decision-Making Developing Countries Development Economic Development Political Development Media Mass Media Radio Telephone Cost-Benefit Analysis Systems Analysis Road(s) Road Construction Investment Choices Substitution in Investment Modernization Model for Development Investment Staging Survey Research Two-Way Radio Two-Way Radio Systems						

Unclassified

Security Classification